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ABSTRACT

This curriculum guide provides a model for a postsecondary electromechanical technology program. It is divided into 10 sections. Section 1 overviews the philosophy, purpose, and goals for vocational education in Georgia. Contents of section 2 include a definition of the guide's purpose and program objective. Section 3 describes the occupational field, discusses employability skills, and provides information on exit points and task listing by Dictionary of Occupational Titles code. Examples of a curriculum structure and course outline are provided in section 4. Section 5 contains the unit guides for 19 units and 185 tasks. Each task contains the following information: task, performance objective, instructional activities, suggested instructional materials, evaluation, and classroom hours. Topics covered include reading blueprints, schematics, and symbols; identifying metal and non-metal materials; plant safety; handtools; elements of mechanics; lubricants and lubrication; drive systems; bearings; pumps; piping systems; hydraulic systems; pneumatic systems; packaging methods; packing machinery; and casing machinery. Section 6 includes an instructional resource matrix, list of textbooks, suppliers of materials, and additional instructional resources. Forms for recording student progress are provided in section 7. Section 8 addresses working with special needs students. Section 9 and 10 contain facility layouts and definitions of terms. (YLB)

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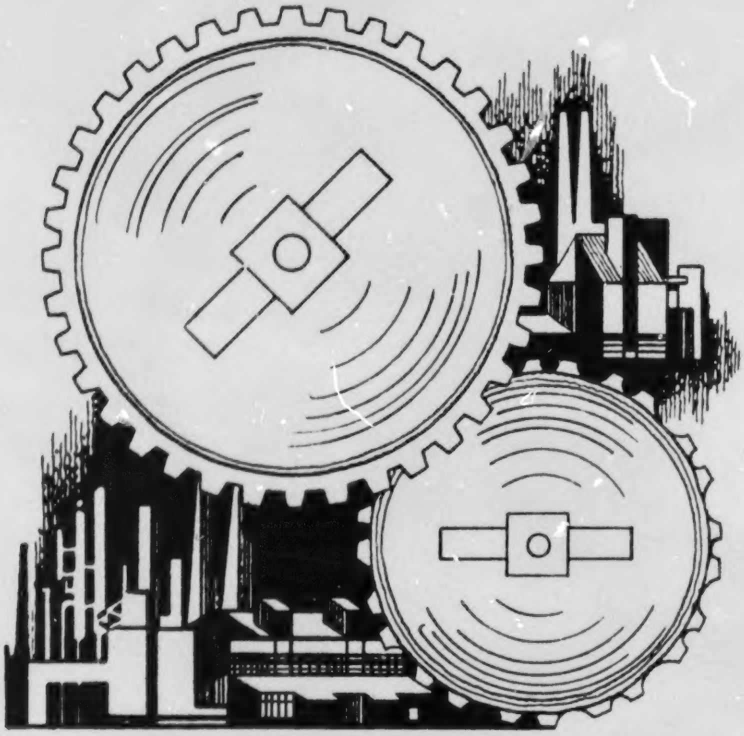
ELECTROMECHANICAL TECHNOLOGY

Post Secondary



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CURRICULUM GUIDE

Georgia Department of Education

ELECTROMECHANICAL TECHNOLOGY

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

ELECTRO-MECHANICAL TECHNOLOGY

Developed By

The University of Georgia

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POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the Division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching of Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center for Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate students.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

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SECTION I

PHILOSOPHY & GOALS

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, high schools, postsecondary area vocational-technical schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

POSTSECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of postsecondary vocational-technical education in Georgia is to improve the economic well-being of adult citizens by providing access to high quality vocational-technical training for skilled and semi-skilled occupations, for improvement of existing skills or for retraining in a new occupation.

B. OBJECTIVES

1. To provide vocational-technical education programs and ancillary services commensurate with the needs and interests of students and available job opportunities.

2. To provide vocational-technical education programs which are current with the state-of-the-art, competency-based, and offer multiple exit points to accomodate the students' occupational objectives.

3. To provide vocational-technical education programs which are articulated with available high school counterparts, to facilitate an easy transition from secondary to postsecondary levels without loss of credit.

4. To provide vocational-technical education programs such that 75% of those individuals who leave or complete a program of occupational preparation will find employment in the field, or a related field, for which trained.

5. To provide those guidance, counseling, financial aid, evaluative, job placement, remedial and other supportive programs and services needed by students to enroll, complete a program and become, or remain, employable in a skilled or semi-skilled occupation.

6. To provide needed assistance to special populations to include women, minorities, limited English-speaking, the displaced homemaker and other displaced workers, the disadvantaged and the handicapped.

7. To provide vocational-technical education programs for full-time and part-time students on campus during the day as well as the evening hours, and to provide appropriate programs for full-time and part-time students off campus in businesses and industries, comprehensive high schools and other locations within the respective schools' service areas.

8. To serve as a center for the delivery of postsecondary and adult vocational-technical education programs and services for the community and assigned service area.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND GOALS FOR VOCATIONAL EDUCATION

SECTION II

PURPOSE & OBJECTIVES

PURPOSE OF GUIDE

The purpose is defined in terms of the functional needs of each of the identified classes of users in the secondary and post secondary systems.

(a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees,
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

(b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

(c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options)
3. Serve as guide for admissions and job placement,
4. Correlate with the new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

This guide will serve as an ideal communication device between school personnel and the craft advisory committee. By personally reviewing the guide with the local craft advisory committee the teacher will be able to maintain the accuracy of the guide in terms of the local job market and will also be able to inform representatives of local industry regarding the content of the program itself.

ELECTRO-MECHANICAL TECHNOLOGY PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Maintenance Mechanic Helper, Maintenance Repairer Helper, Electrical Repairer, Maintenance Repairer and Maintenance Mechanic in the areas of knowledge, theoretical structure, tool usage, diagnostice ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following curriculum exit points.

Maintenance Mechanic Helper	(D.O.T. Code 638.684-018)
Maintenance Repairer Helper	(D.O.T. Code 899.684-022)
Electrical Repairer	(D.O.T. Code 829.281-014)
Maintenance Repairer	(D.O.T. Code 899.281-014)
Maintenance Mechanic	(D.O.T. Code 638.281-014)

SECTION III

D. O. T. DESCRIPTION, EXIT POINTS, TASKS

DESCRIPTION OF OCCUPATIONAL FIELD

The primary purpose of this section is to provide a general orientation to the occupational field. This orientation may be used by counseling and guidance staff in helping students to select subject areas. It may also be used by instructors for new students just entering the program area. The description delimits the scope of the occupational field in terms of the range of activities involved in a series of occupations. It contains information about career potential within the occupational field, including job market conditions and trends.

The description identifies prerequisite skills and knowledge for those students interested in entering the occupational field. In addition, the Description of Occupational Exit Points are provided to aide the instructor in identifying possible jobs for early leavers. A listing of employability skills is also included in this section.

*ELECTRO - MECHANICAL TECHNOLOGY

Nature of the Work

When a machine breaks down in a plant or factory, not only is the machine idle, but raw materials and human resources are wasted. It is the industrial machinery repairer's job to prevent these costly breakdowns and to make repairs as quickly as possible.

Industrial machinery repairers--often called maintenance mechanics--spend much time doing preventive maintenance. This includes keeping machines well oiled and greased, and periodically cleaning parts according to a planned schedule. The repairer regularly inspects machinery and checks performance. Written records are kept of all regular and emergency maintenance and repair. Tools such as micrometers, calipers, and depth gauges are used to measure and align all parts. For example, treadles on sewing machines in the apparel industry may need adjustment and gears and bearings may have to be aligned. By keeping complete and up-to-date records, mechanics try to anticipate trouble and service machinery before the factory's production is interrupted.

When repairs become necessary, the maintenance mechanic must first locate the specific cause of the problem. This challenge requires knowledge reinforced by experience. For example, after detecting a vibration from a machine, the mechanic must decide whether it is due to worn belts, weak motor bearings, or any number of other possibilities. Repairers often follow blueprints and engineering specifications in maintaining and fixing equipment.

After correctly diagnosing the problem the maintenance mechanic disassembles the equipment, and then repairs or replaces the necessary parts. Hand and power tools usually are needed, and the repairer must be proficient in the use of these. The repairer may use a screwdriver and a wrench to take the door off an oven, or a crane to lift a printing press off the ground. Electronic, hydraulic and pneumatic testing equipment often is included in the mechanic's tools. Repairers use catalogs to order replacements for broken or defective parts. When parts are not readily available, or when a machine must be quickly returned to production, repairers may sketch a part that can be fabricated by the plant's machine shop.

The repairer reassembles and tests each piece of equipment after it has been serviced, for once it is back in operation, the machine is expected to work as if it were new.

Working Conditions

Industrial machinery repairers are not usually affected by seasonal changes in production. During slack periods, when some plant workers are laid off, repairers often are retained to do major overhaul jobs. In addition to their regular work schedule, industrial machinery repairers may be called to the plant at night or on weekends for emergency repairs.

Repairers may work in stooped or cramped positions to reach the underside of a generator, for example. They also may work from the top of ladders when repairing a large machine. These workers are subject to common shop injuries such as cuts and bruises. Goggles, metal-tip shoes, safety helmets, and other protective devices help prevent injuries.

Places of Employment

Industrial machinery repairers work in almost every industry in which a great deal of machinery is used. Many of the 655,000 repairers employed in 1978 worked in the following manufacturing industries: Food products, primary metals, machinery, chemicals, fabricated metal products, transportation equipment, paper and rubber.

Because industrial machinery repairers work in a wide variety of plants, they are employed in every section of the country. Employment is concentrated, however, in heavily industrialized areas.

Training, Other Qualifications, and Advancement

Graduation from high school is preferred, but not always required, for entry into this occupation. Courses in mechanical drawing, mathematics, blueprint reading, and physics are useful for those interested in entering this trade.

Most workers who become industrial machinery repairers start as helpers and pick up the skills of the trade informally. Some learn the trade through apprenticeship programs.

Mechanical aptitude and manual dexterity are important qualifications for workers in this trade. Good physical condition and agility are also necessary because repairers sometimes have to lift heavy objects or climb to reach equipment located high above the floor.

Examinations may be administered periodically to determine the repairer's ability to maintain more advanced machinery. Some repairers are promoted to machinists or tool-and-die makers or become master mechanics.

Employment Outlook

Employment of industrial machinery repairers is expected to increase much faster than the average for all occupations through the 1980's. More repairers will be needed as manufacturers invest in more industrial machinery. Also, as machinery becomes more complex, repair work and preventive maintenance will become more time consuming. In addition, many openings will result from the need to replace repairers who retire, die, or transfer to other occupations.

Sources of Additional Information

Information about employment and apprenticeship opportunities in this field may be available from local offices of the State employment service or the following organizations:

International Union, United Automobile, Aerospace, and Agriculture Implement Workers of America, 8000 East Jefferson Ave., Detroit, Mich., 48214.

International Union of Electrical, Radio, and Machine Workers, 1126-16th St. NW., Washington, D.C. 20036.

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* Occupational Outlook Handbook, 1980-81 Edition

*RELATED OCCUPATIONS

MAINTENANCE-MECHANIC HELPER
638.684-018

Assists maintenance mechanic in repairing and maintaining machinery and mechanical equipment. Carries tools and equipment to and from storage and working areas. Holds scaffolding members in place or tightens bolts to erect working platforms about machines. Pulls handlines to raise materials and tools to working levels. Loosens bolts to dismantle machinery. Drills and breaks up concrete, using jackhammer. Digs trenches for machinery foundations. Mixes and pours concrete for foundations. Cleans machines with sandpaper, solvent, and wiping rags to prepare surfaces for painting. Oils and greases machines.

MAINTENANCE-REPAIRER HELPER, FACTORY OR MILL
899.684-022

Assists maintenance repairer in repairing and maintaining machinery, plumbing, physical structure, and electrical wiring and fixtures of commercial and industrial establishments. Bends and cuts conduit, cuts wires, and drills holes in walls, floors, or ceilings for electrical connections. Connects wires to motors, fixtures, and other electrical equipment, replaces switches and fuses, and splices wires and insulates wires with friction tape. Bends, cuts, and threads pipe, cuts openings in walls, ceilings, and floors for pipes, and seals pipe joints with sealing compound or molten lead. Dismantles machines or equipment, replaces defective parts and motors, and adjusts feed mechanisms. Performs routine maintenance on machines such as cleaning and lubricating shafts, pulleys, gears, and bearings, using rags, brushes, grease gun, and oilcan. Cuts out and joins parts for worktables, benches, shelves and other furnishings, using handtools and materials, such as saws, hammers, nails, and screws. Paints walls, ceilings, or fixtures of building. Patches or replaces plaster, clears clogged drains, and replaces washers. Replaces or repairs machine belts. Removes dust, dirt, grease, and waste material from machines. Paints machines or equipment to prevent corrosion.

ELECTRICAL REPAIRER
829.281-014

Repairs, maintains, and installs electrical systems and equipment, such as motors, transformers, wiring, switches, and alarm systems. Locates and determines electrical malfunction, using test instruments. Tasks: Measures, cuts, and bends wire and conduit, using ruler and handtools. Drills holes for wiring, using power drill, and pulls or pushes wiring through opening. Assists in lifting, positioning, and fastening objects, such as wiring, conduit, and motors. Performs minor repairs, such as replacing fuses, light sockets, bulbs, and switches, using handtools. Maintains tools and equipment and keeps supplies and parts in order. Disassembles defective electrical equipment, such as motors, using handtools.

MAINTENANCE REPAIRER, FACTORY OR MILL
899.281-014

Repairs and maintains machinery, plumbing, physical structure, and electrical wiring and fixtures of commercial and industrial establishments in accordance with blueprints, manuals, and building codes, using handtools and carpenter's, electrician's and plumber's tools. Inspects machinery and mechanical equipment for defects. Dismantles machines or equipment to gain access to defective parts, and repairs them, using handtools. Repaires canvas, leather, or rubber drive belts and replaces them on machines. Cleans and lubricates shafts, bearings, gears, pulleys, and other parts of machine, using rags, brushes, and grease gun. Measures, cuts, and installs pipe and tubing for gas, water, and hydraulic lines, using ratchet, cutting die, and threading die. Repairs and replaces gages, valves, pressure regulators, and other plumbing equipment, and opens clogged drains, using plunger and plumber's tools. Installs electrical equipment and repairs or replaces wiring and fixtures. Makes and repairs counters, benches, partitions, and other wooden structures, using saws, braces, bits, and other carpenter's tools. Paints walls, floors, woodwork, and fixtures of establishment, using spray gun and brushes. Replaces and repairs brick and plaster walls, using trowel. May set up and operate machines, such as lathe and milling machine, to repair or fabricate new parts. May operate gas- or arc-welding equipment to join metal parts used to repair or fabricate equipment.

MAINTENANCE MECHANIC
638.281-014

Repairs and maintains, in accordance with diagrams, sketches, operation manuals, and manufacturer's specifications, machinery and mechanical equipment, such as engines, motors, pneumatic tools, conveyor systems, and production machines and equipment, using handtools, power tools, and precision-measuring and testing instruments. Observes mechanical devices in operation and listens to their sounds to locate causes of trouble. Dismantles devices to gain access to and remove defective parts, using hoists, cranes, handtools, and power tools. Examines form and texture of parts to detect imperfections. Inspects used parts to determine changes in dimensional requirements, using rules, calipers, micrometers, and other measuring instruments. Adjusts functional parts of devices and controls instruments, using handtools, levels, plumb bobs, and straightedges. Repairs or replaces defective parts, using handtools and power tools. Installs special functional and structural parts in devices, using handtools. Starts devices to test their performance. Lubricates and cleans parts. May set up and operate lathe, drill press, grinder, and other metalworking tools to make and repair parts. May initiate purchase order for parts and machines. May repair electrical equipment.

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* D.O.T. Code

EMPLOYABILITY SKILLS

In addition to the aptitudes, abilities, interests, physical requirements and job skills listed in the preceding Description of Occupation, employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    - a. Filling out job applications
    - b. Developing a resume
    - c. Preparing for a job interview

2. Keeping a job
    - a. Be on time and regular in attendance
    - b. Maintain a fair share of the work-load
    - c. Work without supervision
    - d. Meet production schedules
    - e. Properly care for and use equipment
    - f. Dress appropriately for the job
    - g. Maintain good personal hygiene
    - h. Develop and maintain good communication with supervisors and co-workers

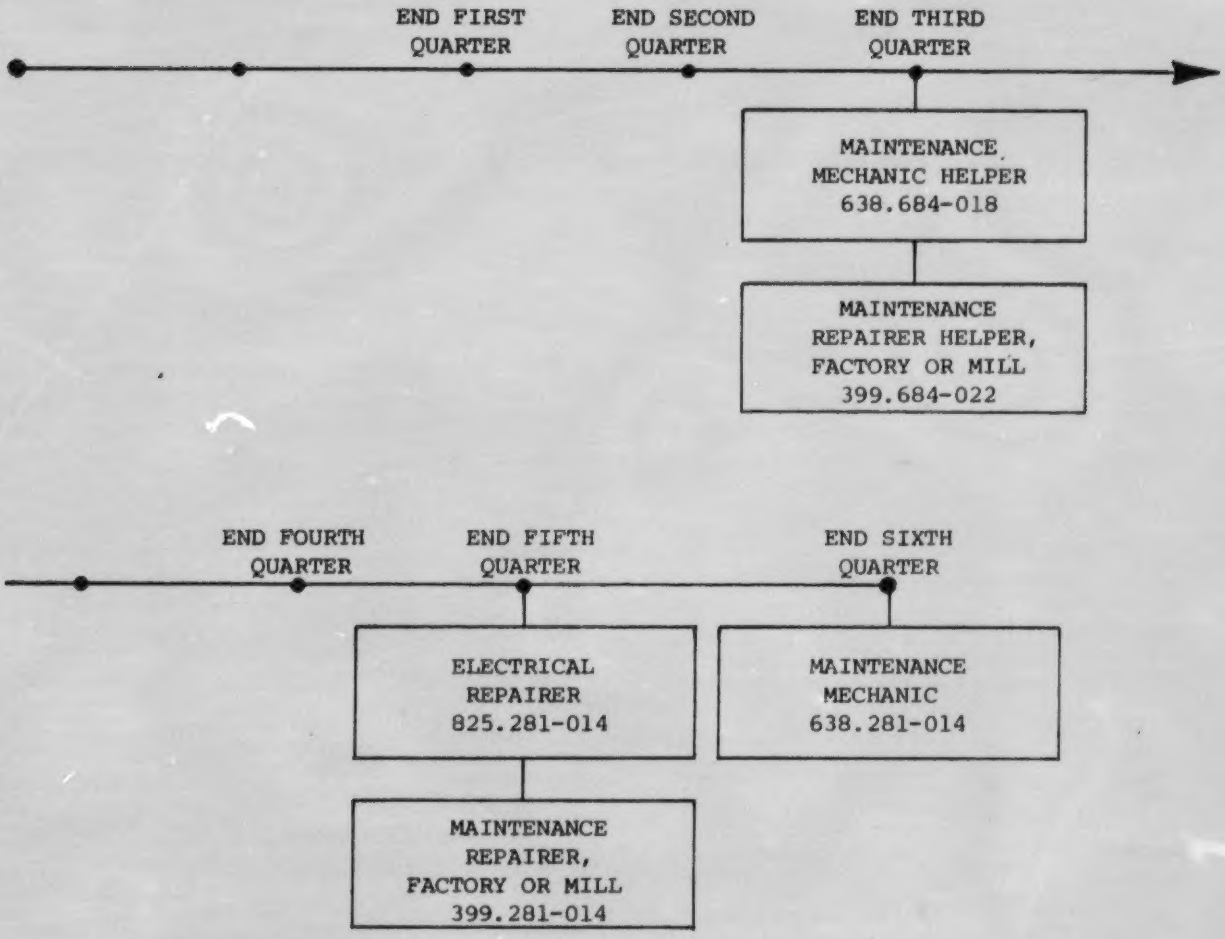
ELECTRO-MECHANICAL TECHNOLOGY EXIT POINTS

The diagram on the following page is based on the Suggested Course Outline Structure. It graphically illustrates the points in the Electro-Mechanical Technology program where the student should have acquired the competencies necessary for entry level employment into the job classifications indicated. In many cases by the time a student reaches an exit point he/she may have acquired several competencies in addition to those required for the specific job classification.

The course outline is structured to prepare students to become Maintenance Mechanic Helpers, Maintenance Repairer Helpers, Electrical Repairers, Maintenance Repairers and Maintenance Mechanics.

The Task Listing by D.O.T. Code indicates the entry level skills (tasks) required for the student to be considered employable in a specified occupation. If the local program is individualized it should be relative easy to move a potential program leaver (drop out) into those skills (tasks) which would qualify the student for one of the listed occupations.

ELECTRO-MECHANICAL TECHNOLOGY
EXIT POINTS


END FIRST QUARTER
END SECOND QUARTER
END THIRD QUARTER
MAINTENANCE MECHANIC HELPER 638.684-018
MAINTENANCE REPAIRER HELPER, FACTORY OR MILL 399.684-022
END FOURTH QUARTER
END FIFTH QUARTER
END SIXTH QUARTER
ELECTRICAL REPAIRER 825.281-014
MAINTENANCE MECHANIC 638.281-014
MAINTENANCE REPAIRER, FACTORY OR MILL 399.281-014

TASK LISTING BY D.O.T. CODE

The tasks are listed in this section in a matrix format that cross references them with the applicable D.O.T. codes for the exit point occupational titles. Each task is identified with one or more of the exit point occupational titles. This information may be used to make specific determination as to when a student has developed the necessary skills to qualify for an exit point. This information is particularly useful in preparing early leavers to meet the requirements for a specific occupational title.

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
	DUTY A: Basic Blueprint Reading						
BBR-01	Identifying basic principles of blueprint reading	X	X	X	X		
BBR-02	Identifying elements of machine drawings	X					
BBR-03	Identifying hydraulic and pneumatic drawings	X		X	X		
BBR-04	Using machine drawings in the maintenance of machinery and equipment	X					
BBR-05	Reading building drawings	X	X	X			
BBR-06	Reading electrical drawings	X	X	X			
BBR-07	Reading pipe system drawings	X		X			
BBR-08	Reading sheet metal drawings	X		X			
BBR-09	Using shop math to interpret blueprints	X	X				
BBR-10	Sketching schematic diagrams	X	X				

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Maintenance Mechanic DOT NO.: 638.281-014	Electrical Repairer 829.281-014	Maintenance Repairer (Factory or Mill) 899.281-014	Maintenance Mechanic Helper 638.684-018	Maintenance Repairer Helper 899.684-022	
	DUTY B: Reading Schematics and Symbols						
RSS-01	Identifying types of schematics used in plant engineering	X	X	X	X		
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams	X	X	X			
RSS-03	Identifying guidelines for reading schematics	X	X	X			
RSS-04	Identifying electrical symbols	X	X	X			
RSS-05	Reading electrical diagrams	X	X	X			
RSS-06	Identifying piping symbols	X		X			
RSS-07	Reading piping schematics	X		X			
RSS-08	Identifying fluid power symbols	X		X			
RSS-09	Reading fluid power schematics	X		X			
RSS-10	Identifying welding symbols	X		X			
	DUTY C: Metal Materials						

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT DESCRIPTIONS / DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
MM-01	Identifying the physical structure of metals	X		X	X		
MM-02	Identifying properties of metals	X		X	X		
MM-03	Identifying methods of heat treatment	X					
MM-04	Identifying metal manufacturing processes	X					
MM-05	Identifying iron manufacturing processes	X					
MM-06	Identifying processes used to produce steel	X					
MM-07	Identifying processes used to produce aluminum	X					
MM-08	Identifying processes for the production of magnesium and titanium	X					
MM-09	Identifying processes used to produce copper	X					
MM-10	Identifying processes used to produce lead, nickel, tin and zinc	X					

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

		POSSIBLE EXIT POINTS					
		DOT DESCRIPTIONS: Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
TASK NO.	**TASK NAME**	DOT NO.: 638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
	DUTY D: Non-Metal Materials						
NMM-01	Identifying non-metal material	X		X	X		
NMM-02	Identifying properties of plastics	X		X	X		
NMM-03	Identifying properties of rubber	X		X	X		
NMM-04	Identifying properties and applications of carbon	X		X	X		
NMM-05	Identifying industrial chemicals and their applications	X		X	X		
NMM-06	Identifying paints, coatings and their applications	X		X	X		
NMM-07	Identifying insulating materials and their applications	X		X	X		
NMM-08	Identifying properties and applications of construction materials	X		X	X		
NMM-09	Identifying properties and applications of wood	X		X	X		

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

		POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
TASK NO.	TASK NAME / DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
NMM-10	Identifying adhesives and tapes	X	X	X	X		
	DUTY E: Tools						
T-01	Identifying and using measuring tools	X	X	X	X		
T-02	Identifying and using wrenches and screwdrivers	X	X	X	X		
T-03	Identifying and using pipefitting tools	X	X	X	X		
T-04	Identifying and using plumbing tools	X		X	X		
T-05	Identifying and using electrical tools	X	X	X	X		
T-06	Identifying and using cement, plaster and glazing tools	X		X	X		
T-07	Identifying and using wood-working tools	X		X	X		
T-08	Identifying and using sheet metal tools	X		X	X		

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
T-09	Identifying and using metal working tools	X		X	X		
T-10	Identifying and using hoisting and pulling tools	X		X	X		
	DUTY F: Plant Safety						
SP-01	Identifying plant safety procedures	X	X	X	X	X	
SP-02	Identifying work area safety	X	X	X	X	X	
SP-03	Observing safety in handling materials	X	X	X	X	X	
SP-04	Observing safety precautions for tools and equipment	X	X	X	X	X	
SP-05	Identifying machinery safeguards	X	X	X	X	X	
SP-06	Identifying personal protection gear	X	X	X	X	X	
SP-07	Observing electrical safety precautions	X	X	X	X	X	
SP-08	Handling hazardous materials	X	X	X	X	X	
SP-09	Identifying fire prevention procedures	X	X	X	X	X	
	DUTY G: Elements of Mechanics						

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Maintenance Mechanic 638.281-014	Electrical Repairer 829.281-014	Maintenance Repairer (Factory or Mill) 899.281-014	Maintenance Mechanic Helper 638.684-018	Maintenance Repairer Helper 899.684-022	
	DOT DESCRIPTIONS / DOT NO.						
EM-01	Identifying the nature of force	X	X				
EM-02	Identifying physical properties of motion	X	X				
EM-03	Identifying principles of work and energy	X	X				
EM-04	Identifying principles of simple machines	X	X				
EM-05	Identifying practical applications of power	X	X				
EM-06	Calculating area and volume	X	X				
EM-07	Identifying and using hand tools	X	X	X	X	X	
EM-08	Identifying and using power tools	X	X	X	X	X	
EM-09	Identifying types of fasteners	X	X	X	X	X	
EM-10	Identifying properties of friction	X	X				
	DUTY H: Lubricants						
L-01	Identifying basic principles of lubrication	X		X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Maintenance Mechanic DOT NO.: 638.281-014	Electrical Repairer 829.281-014	Maintenance Repairer (Factory or Mill) 899.281-014	Maintenance Mechanic Helper 638.684-018	Maintenance Repairer Helper 899.684-022	
L-02	Identifying characteristics of lubricants	X		X	X	X	
L-03	Identifying additives, lubricating action and bearing lubrication	X		X	X	X	
L-04	Identifying oils and their applications	X		X	X	X	
L-05	Identifying general purpose greases	X		X	X	X	
L-06	Identifying special purpose greases	X		X	X	X	
L-07	Identifying lubricating compounds	X		X	X	X	
L-08	Identifying lubrication systems and methods	X		X	X	X	
L-09	Identifying automatic lubrication methods	X		X	X	X	
L-10	Identifying methods of lubricant storage and handling	X		X	X	X	
	DUTY I: Drive Systems						
DS-01	Identifying common couplings	X		X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

	POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
TASK NO.	**TASK NAME**						
DS-02	Identifying special couplings	X		X	X	X	
DS-03	Identifying clutches	X		X	X	X	
DS-04	Identifying V-belt drives	X		X	X	X	
DS-05	Identifying chain drives	X		X	X	X	
DS-06	Identifying speed reducers	X		X	X	X	
DS-07	Identifying gears	X		X	X	X	
DS-08	Identifying variable speed reducers	X		X	X	X	
DS-09	Identifying brakes and motors	X	X	X	X	X	
	DUTY J: Bearings						
B-01	Identifying principles of bearings and shafts	X		X	X	X	
B-02	Identifying plain journal bearings	X		X	X	X	
B-03	Identifying anti-friction bearings	X		X	X	X	
B-04	Identifying ball and roller bearings	X		X	X	X	
B-05	Identifying specialized bearings	X		X	X	X	
B-06	Identifying bearing seals	X		X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
B-07	Identifying methods of bearing lubrication	X		X	X	X	
B-08	Maintaining bearings	X		X	X	X	
	DUTY K: Pumps						
P-01	Identifying pump applications	X		X	X	X	
P-02	Selecting a pump	X		X			
P-03	Identifying centrifugal pumps	X		X	X	X	
P-04	Identifying propeller and turbine pumps	X		X	X	X	
P-05	Identifying rotary pumps	X		X	X	X	
P-06	Identifying reciprocating pumps	X		X	X	X	
P-07	Identifying metering pumps	X		X	X	X	
P-08	Identifying special purpose pumps	X		X	X	X	
P-09	Installing packings and maintaining pump seals	X		X	X	X	
P-10	Performing pump maintenance	X		X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
	DUTY L: Piping Systems						
PS-01	Identifying piping systems and piping system maintenance	X		X	X	X	
PS-02	Maintaining metal pipe	X		X	X	X	
PS-03	Maintaining non-metallic piping	X		X	X	X	
PS-04	Maintaining tubing	X		X	X	X	
PS-05	Maintaining hoses	X		X	X	X	
PS-06	Maintaining fittings	X		X	X	X	
PS-07	Maintaining common valves	X		X	X	X	
PS-08	Identifying specialized valves	X		X	X	X	
PS-09	Maintaining strainers, filters and traps	X		X	X	X	
PS-10	Maintaining pipelines by monitoring accessories	X		X			
	DUTY M: Basic Hydraulics						
BH-01	Identifying principles of hydraulics	X		X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

		POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
TASK NO.	TASK NAME / DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
BH-02	Identifying hydraulic fluids	X		X	X	X	
BH-03	Identifying strainers and filters in hydraulic systems	X		X	X	X	
BH-04	Identifying reservoirs and accumulators in a hydraulic system	X		X	X	X	
BH-05	Identifying hydraulic pumps on a system	X		X	X	X	
BH-06	Identifying piping, tubing and fittings	X		X	X	X	
BH-07	Identifying directional control valves	X		X	X	X	
BH-08	Identifying pressure control valves	X		X	X	X	
BH-09	Identifying cylinders in a hydraulic system	X		X	X	X	
BH-10	Identifying hydraulic motors	X		X	X	X	
	Duty N: Troubleshooting Hydraulic Systems						

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper
DOT NO.		638.281-014	829.281-014	899.281-014	638.684-018	899.684-022
THS-01	Troubleshooting hydraulic systems (schematics)	X		X		
THS-02	Reading hydraulic schematic diagrams	X		X		
THS-03	Installing hydraulic components	X		X	X	X
THS-04	Installing pipes and tubes	X		X	X	X
THS-05	Selecting hydraulic fluids	X		X		
THS-06	Planning system maintenance	X		X		
THS-07	Troubleshooting hydraulic systems (diagnostic technique)	X		X		
THS-08	Troubleshooting valves	X		X		
THS-09	Troubleshooting cylinders	X		X		
THS-10	Troubleshooting pumps and motors	X		X		
	DUTY O: Basic Pneumatics					
BP-01	Identifying pneumatic principles	X		X	X	X
BP-02	Identifying reciprocating compressors	X		X	X	X
BP-03	Identifying rotary compressors	X		X	X	X

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

		POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
TASK NO.	TASK NAME / DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
BP-04	Identifying primary air treatment in pneumatic systems	X		X	X	X	
BP-05,	Identifying secondary air treatment in pneumatic systems	X		X	X	X	
BP-06	Identifying piping, hoses and fittings used in pneumatic systems	X		X	X	X	
BP-07	Identifying control valves	X		X	X	X	
BP-08	Identifying pressure relief valves	X		X	X	X	
BP-09	Identifying cylinders	X		X	X	X	
BP-10	Identifying motors	X		X	X	X	
	DUTY P: Pneumatic Troubleshooting						
PT-01	Identifying components of pneumatic systems	X		X	X	X	
PT-02	Reading pneumatic schematic diagrams	X		X			
PT-03	Installing system components	X		X	X	X	
PT-04	Identifying procedures for pneumatic system maintenance	X		X			

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS DOT DESCRIPTIONS: Maintenance Mechanic DOT NO.: 638.281-014	Electrical Repairer 829.281-014	Maintenance Repairer (Factory or Mill) 899.281-014	Maintenance Mechanic Helper 638.684-018	Maintenance Repairer Helper 899.684-022	
PT-05	Determining system failures	X		X			
PT-06	Troubleshooting air compressors	X		X			
PT-07 .	Troubleshooting control valves	X		X			
PT-08	Troubleshooting cylinders	X		X			
PT-09	Troubleshooting motors	X		X			
PT-10	Troubleshooting pneumatic/hydraulic systems	X		X			
	DUTY Q: Introduction to Packaging						
IP-01	Identifying basic packaging methods	X	X	X	X	X	
IP-02	Identifying actuating mechanisms	X	X	X	X	X	
IP-03	Identifying basic troubleshooting principles of packaging machinery	X	X	X			
IP-04	Identifying mechancial drives	X	X	X	X	X	
IP-05	Identifying motors and brakes	X	X	X	X	X	
IP-06	Identifying electrical controls	X	X	X	X	X	
IP-07	Identifying packaging materials	X	X	X	X	X	

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

	POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
TASK NO.	**TASK NAME**						
IP-08	Identifying methods of filling containers	X		X	X	X	
IP-09	Identifying methods of sealing	X		X	X	X	
IP-10	Identifying methods of weighing and measuring	X		X	X	X	
	DUTY R: Packing Machinery						
PM-01	Identifying methods of gravity and vacuum filling	X		X			
PM-02	Identifying procedures for bottle filling and capping	X		X			
PM-03	Identifying methods for pressure liquid filling	X		X			
PM-04	Identifying aerosol fillers	X		X			
PM-05	Identifying methods of bag-forming and filling	X		X			
PM-06	Identifying methods of pouch filling	X		X			

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS DOT DESCRIPTIONS / DOT NO. Maintenance Mechanic 638.281-014	Electrical Repairer 829.281-014	Maintenance Repairer (Factory or Mill) 899.281-014	Maintenance Mechanic Helper 638.684-018	Maintenance Repairer Helper 899.684-022	
PM-07	Identifying volumetric filling machines	X		X			
PM-08,	Identifying filling by count machines	X		X			
PM-09	Identifying methods of positive displacement filling	X		X			
PM-10	Identifying methods of blister packing	X		X			
	DUTY S: Casing Machinery						
CM-01	Identifying procedures for uncasing and unscrambling	X		X			
CM-02	Identifying procedures for cleaning and washing containers	X		X			
CM-03	Identifying gathering machines	X		X			
CM-04	Identifying cartoning machines	X		X			
CM-05	Identifying casing machines	X		X			
CM-06	Identifying wrapping machines	X		X			
CM-07	Strapping and stitching packages	X		X			

TASK LISTING BY DOT CODE

Electro-Mechanical Technology

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Maintenance Mechanic	Electrical Repairer	Maintenance Repairer (Factory or Mill)	Maintenance Mechanic Helper	Maintenance Repairer Helper	
	DOT NO.	638.281-014	829.281-014	899.281-014	638.684-018	899.684-022	
TASK NO.	TASK NAME						
CM-08	Identifying adhesives and their applications	X		X			
CM-09,	Identifying procedures for labeling and coding	X		X			
CM-10	Identifying procedures for maintenance and safety of casing machinery	X		X			

SECTION IV

CURRICULUM STRUCTURE & COURSE OUTLINE

Curriculum Structure

The following example of curriculum structure is provided to illustrate one way an Electro-Mechanical Technology curriculum may be structured. The example is not intended to imply there are not other ways to structure the curriculum.

The structure is based on the curriculum outline. The time estimates vary according to local program objectives. The actual amount of time required for each course will depend upon the instructor, the student and facilities available.

Instructors are encouraged to structure their curriculum and make time estimates based on their experiences, industry requirements, students' needs and the local facilities (classroom, equipment, lab) available.

ELECTRO-MECHANICAL TECHNOLOGY

CURRICULUM STRUCTURE

Course Number	Course	Clock Hours
	First Quarter	
	Basic Blueprint Reading	84
	Reading Schematics and Symbols	96
	Metal Materials	12
	Non-Metal Materials	12
	Tools	66
	Plant Safety	18
	Related Instruction	34
		312
	Second Quarter	
	Elements of Mechanics	24
	Lubrication	56
	Drive Components	76
	Bearings	76
	Related Instruction	88
		312
	Third Quarter	
	Pumps	24
	Piping Systems	24
	Basic Hydraulics	52
	Hydraulic Troubleshooting	84
	Basic Pneumatics	52
	Pneumatic Troubleshooting	76
		312

Course Number	Course	Clock Hours
	Fourth Quarter	
	Machinery Fundamentals - One	96
	Machinery Fundamentals - Two	96
	Related Instruction	120
		312
	Fifth Quarter	
	Packing Machinery Maintenance - One	102
	Packing Machinery Maintenenace - Two	90
	Related Instruction	120
		312
	Sixth Quarter	
	Casing Machinery Maintenance - One	80
	Casing Machinery Maintenance - Two	112
	Related Instruction	120
		312
	Seventh Quarter (Option)	
	Practicum	312

Course Outline

The sample course outline is to be used as an example to facilitate the development of alternative outlines for the individual learner. The listing of tasks within a quarter is not meant to indicate a required sequence or pattern. All the tasks are independent, therefore, a group of student may begin the quarters by learning different tasks. This allows better coordination of the laboratory hours and the learning objectives may be selected according to the type of laboratory facilities available. The specific information required to teach the skills for each unit/task is included on the corresponding unit guide sheet in the Unit Guide section.

The time estimations for completion of the activities are expressed as a minimum and should be extended according to the learner's individual needs. The laboratory hours are not included in each performance group, however, they are noted at the end of each quarter.

SUGGESTED COURSE OUTLINE STRUCTURE FOR ELECTRO-MECHANICAL TECHNOLOGY

Quarter I

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Reading Basic Blueprints	
BBR-01	Identifying basic principles of blueprint reading	5
BBR-02	Identifying elements of machine drawings	5
BBR-03	Identifying hydraulic and pneumatic drawings	5
BBR-04	Using machine drawings in the maintenance of machinery and equipment	20
BBR-05	Reading building drawings	5
BBR-06	Reading electrical drawings	5
BBR-07	Reading pipe system drawings	4
BBR-08	Reading sheet metal drawings	5
BBR-09	Using shop math to interpret blueprints	20
BBR-10	Sketching schematic diagrams	10
	Performance Group: Reading Schematics and Symbols	
RSS-01	Identifying types of schematics used in plant engineering	15
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams	30
RSS-03	Identifying guidelines for reading schematics	5
RSS-04	Identifying electrical symbols	5
RSS-05	Reading electrical diagrams	10
RSS-06	Identifying piping symbols	5
RSS-07	Reading piping schematics	10
RSS-08	Identifying fluid power symbols	5
RSS-09	Reading fluid power schematics	5
RSS-10	Identifying welding symbols	6
	Performance Group: Identifying Metal Materials	
MM-01	Identifying the physical structure of metals	2
MM-02	Identifying properties of chemicals	2
MM-03	Identifying methods of heat treatment	2
MM-04	Identifying metal manufacturing processes	2
MM-05	Identifying iron manufacturing processes	2
MM-06	Identifying processes used to produce steel	2
MM-07	Identifying processes used to produce aluminum	2
MM-08	Identifying processes for the production of magnesium and titanium	2
MM-09	Identifying processes used to produce copper	2

Unit/task	Title	Hours (classroom and lab)
MM-10	Identifying processes used to produce lead, nickel, tin and zinc	2
	Performance Group: Identifying Non-Metal Materials	
NMM-01	Identifying non-metal materials	2
NMM-02	Identifying properties of plastics	2
NMM-03	Identifying properties of rubber	2
NMM-04	Identifying properties and applications of carbon	2
NMM-05	Identifying industrial chemicals and their applications	2
NMM-06	Identifying paints, coatings and their applications	2
NMM-07	Identifying insulating materials and their applications	2
NMM-08	Identifying properties and applications of construction materials	2
NMM-09	Identifying properties and applications of wood	2
NMM-10	Identifying adhesives and tapes	2
	Performance Group: Identifying and Using Hand and Power Tools	
T-01	Identifying and using measuring tools	6
T-02	Identifying and using wrenches and screwdrivers	6
T-03	Identifying and using pipefitting tools	6
T-04	Identifying and using plumbing tools	6
T-05	Identifying and using electrical tools	6
T-06	Identifying and using cement plaster and glazing tools	6
T-07	Identifying and using wood working tools	6
T-08	Identifying and using sheet metal tools	6
T-09	Identifying and using metal working tools	6
T-10	Identifying and using hoisting and pulling tools	6
	Performance Group: Observing Plant Safety	
SP-01	Identifying plant safety procedures	2
SP-02	Identifying work area safety	2
SP-03	Observing safety in handling materials	2
SP-04	Observing safety precautions for tools and equipment	2
SP-05	Identifying machinery safeguards	2
SP-06	Identifying personal protection gear	2
SP-07	Observing electrical safety precautions	2
SP-08	Handling hazardous materials	2
SP-09	Identifying fire prevention procedures	2
		293

Classroom and Lab Hours:	293
Related Instruction Hours:	19
Quarter I Total Hours	312

Quarter II

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Identifying Elements of Mechanics	
EM-01	Identifying the nature of force	3
EM-02	Identifying physical properties of motion	3
EM-03	Identifying principles of work and energy	3
EM-04	Identifying principles of simple machines	2
EM-05	Identifying practical applications of power	2
EM-06	Calculating area and volume	2
EM-07	Identifying and using hand tools	3
EM-08	Identifying and using power tools	3
EM-09	Identifying types of fasteners	1
EM-10	Identifying properties of friction	2
	Performance Group: Identifying Lubricants and Lubrication	
L-01	Identifying basic principles of lubrication	6
L-02	Identifying characteristics of lubricants	3
L-03	Identifying additives, lubricating action and bearing lubrication	6
L-04	Identifying oils and their applications	6
L-05	Identifying general purpose greases	6
L-06	Identifying lubricating compounds	6
L-07	Identifying lubrication systems and methods	18
L-08	Identifying automatic lubrication methods	3
L-09	Identifying methods of lubricant storage and handling	2
	Performance Group: Maintaining Drive Systems	
DS-01	Identifying common couplings	6
DS-02	Identifying special couplings	3
DS-03	Identifying clutches	6
DS-04	Identifying V-belt drives	6
DS-05	Identifying chain drives	6
DS-06	Identifying special reducers	6
DS-07	Identifying gears	6
DS-08	Identifying variable speed reducers	6
DS-09	Identifying brakes and motors	23
	Performance Group: Maintaining Bearings	
B-01	Identifying principles of bearings and shafts	12
B-02	Identifying plain journal bearings	6
B-03	Identifying anti-friction bearings	6
B-04	Identifying ball and roller bearings	6
B-05	Identifying specialized bearings	6
B-06	Identifying bearing seals	6
B-07	Identifying methods of bearing lubrication	10
B-08	Maintaining bearings	24
		224

Classroom and Lab Hours:	224
Related Instruction Hours:	88
Quarter II Total Hours:	312

Quarter III

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Maintaining Pumps	
P-01	Identifying pump applications	2
P-02	Selecting a pump	2
P-03	Identifying centrifugal pumps	2
P-04	Identifying propeller and turbine pumps	2
P-05	Identifying rotary pumps	2
P-06	Identifying reciprocating pumps	2
P-07	Identifying metering pumps	2
P-08	Identifying special purpose pumps	2
P-09	Installing packings and maintaining pump seals	5
P-10	Performing pump maintenance	3
	Performance Group: Maintaining Piping Systems	
PS-01	Identifying piping systems and piping system maintenance	2
PS-02	Maintaining metal pipe	2
PS-03	Maintaining non-metallic piping	2
PS-04	Maintaining tubing	2
PS-05	Maintaining hoses	2
PS-06	Maintaining fittings	2
PS-07	Maintaining common valves	2
PS-08	Identifying specialized valves	
PS-09	Maintaining strainers, filters and traps	5
PS-10	Maintaining pipelines by monitoring accessories	4
	Performance Group: Maintaining Basic Hydraulic Systems	
BH-01	Identifying principles of hydraulics	5
BH-02	Identifying hydraulic fluids	5
BH-03	Identifying strainers and filters in hydraulic systems	5
BH-04	Identifying reservoirs and accumulators in a hydraulic system	5
BH-05	Identifying hydraulic pumps on a system	5
BH-06	Identifying piping, tubing and fittings	5
BH-07	Identifying directional control valves	5
BH-08	Identifying pressure control valves	5
BH-09	Identifying cylinders in a hydraulic systems	5
BH-10	Identifying hydraulic motors	7
	Performance Group: Troubleshooting Hydraulic Systems	
THS-01	Troubleshooting hydraulic systems (schematics)	10

Unit/task	Title	Hours (classroom and lab)
THS-02	Reading hydraulic schematic diagrams	10
THS-03	Installing hydraulic components	10
THS-04	Installing pipes and tubes	8
THS-05	Selecting hydraulic fluids	6
THS-06	Planning system maintenance	5
THS-07	Troubleshooting hydraulic systems (diagnostic technique)	10
THS-08	Troubleshooting valves	5
THS-09	Troubleshooting cylinders	10
THS-10	Troubleshooting pumps and motors	10
	Performance Group: Maintaining Basic Pneumatic Systems	
BP-01	Identifying pneumatic principles	5
BP-02	Identifying reciprocating compressors	5
BP-03	Identifying rotary compressors	5
BP-04	Identifying primary air treatment in pneumatic systems	5
BP-05	Identifying secondary air treatment in pneumatic systems	5
BP-06	Identifying piping, hoses and fittings used in pneumatic systems	10
BP-07	Identifying control valves	5
BP-08	Identifying pressure relief valves	5
BP-09	Identifying cylinders	3
BP-10	Identifying motors	4
	Performance Group: Troubleshooting Pneumatic Systems	
PT-01	Identifying components of pneumatic systems	5
PT-02	Reading pneumatic schematic diagrams	5
PT-03	Installing system components	5
PT-04	Identifying procedures for pneumatic system maintenance	10
PT-05	Determining system failures	10
PT-06	Troubleshooting air compressors	10
PT-07	Troubleshooting control valves	10
PT-08	Troubleshooting cylinders	5
PT-09	Troubleshooting motors	10
PT-10	Troubleshooting pneumatic/hydraulic systems	6
		311
	Classroom and Lab Hours:	311
	Related Instruction Hours:	1
	Quarter III Total Hours:	312

Quarter IV

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Identifying Basic Packaging Methods	
IP-01	Identifying basic packaging methods	6
IP-02	Identifying actuating mechanisms	18
IP-03	Identifying basic troubleshooting principles of packaging machinery	30
IP-04	Identifying mechanical drives	6
IP-05	Identifying motors and brakes	36
IP-06	Identifying electrical controls	60
IP-07	Identifying packaging materials	6
IP-08	Identifying methods of filling containers	6
IP-09	Identifying methods of sealing	6
IP-10	Identifying methods of weighing and measuring	18
		192

Classroom and Lab Hours:	192
Related Instruction Hours:	120
Quarter IV Total Hours:	312

Quarter V

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Maintaining Packing Machinery	
PM-01	Identifying methods of gravity and vacuum filling	18
PM-02	Identifying procedures for bottle filling and capping	18
PM-03	Identifying methods for pressure liquid filling	24
PM-04	Identifying aerosol fillers	30
PM-05	Identifying methods of bag forming and filling	12
PM-06	Identifying methods of pouch filling	12
PM-07	Identifying volumetric filling machines	18
PM-08	Identifying filling by count machines	12
PM-09	Identifying methods of positive displacement filling	18
PM-10	Identifying methods of blister packing	30
		192

Classroom and Lab Hours:	192
Related Instruction Hours:	120
Quarter V Total Hours:	312

Quarter VI

Unit/task	Title	Hours (classroom and lab)
	Performance Group: Maintaining Casing Machinery	
CM-01	Identifying procedures for uncasing and unscrambling	10
CM-02	Identifying procedures for cleaning and washing containers	10
CM-03	Identifying gathering machines	20
CM-04	Identifying cartoning machines	20
CM-05	Identifying casing machines	20
CM-06	Identifying wrapping machines	20
CM-07	Strapping and stitching packages	30
CM-08	Identifying adhesives and their applications	20
CM-09	Identifying procedures for labeling and coding	20
CM-10	Identifying procedures for maintenance and safety of casing machinery	22
		192

Classroom and Lab Hours:	192
Related Instruction Hours:	120
Quarter VI Total Hours:	312

SECTION V

UNIT GUIDES

UNIT GUIDES

Description

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with other tasks to fit the individual teacher's own preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment, and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstration, use of audio visuals, and practical applications.

INSTRUCTIONAL MATERIALS: The materials that are necessary to carry out the instructional activities are listed. These include textbooks, audio visuals and equipment.

EVALUATION: This section contains a criterion referenced measure (where appropriate) and reference to any test items or other evaluation measures that are available to the teacher. The criterion referenced measure contains three parts--Condition, Performance and Standard.

CLASSROOM HOURS: The estimated time for completion of the instructional activities and the evaluation are indicated. This time estimate is stated in hours of classroom time related to each task.

TASK

BBR-01 Identifying basic principles of blueprint reading

PERFORMANCE OBJECTIVE

Identify basic principles of blueprint reading.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Blueprints
   1. Purpose
   2. Why blueprints are used
b. Title block
   1. Name
   2. Scale
   3. Assembly drawing number
   4. Unit or assembly
   5. Drawing number
   6. Part number
   7. Required parts
   8. Drafting room record
   9. Material
   10. Limits
c. Lines
d. Notes
e. Reason for more than one view of an object
   1. Auxiliary views
   2. Sections
   3. Pictorial drawings

Provide Practical Application On:

Read basic information on a blueprint and interpret its meaning.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson One

Tools and Equipment:

Blueprints

CLASSROOM HOURS 5

EVALUATION (BBR-01)

Given a blueprint, the student will read and interpret the basic data on the blueprint. The reading must meet standards as set by the instructor.

TASK

BBR-02 Identifying elements of machine drawings

PERFORMANCE OBJECTIVE

Identify elements of machine drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Machine blueprints
b. Introduction to fasteners
c. Screw threads
    1. Helix
    2. External
    3. Internal
    4. Root
    5. Crest
d. How screw threads are shown on drawings
e. Screw thread specifications
    1. Reading thread specifications
    2. ANSI
    3. Bolts
    4. Studs
    5. Cap screw
    6. Machine screw
f. Other forms of fastening
    1. Rivets
    2. Welding
g. Transmitting forces within machines
    1. Pin fasteners
    2. Keys
    3. Extension spring
    4. Compression spring
    5. Torsion spring
h. Gear drawings
    1. Gears
    2. Mesh
    3. Spur gears
    4. Bevel gears
    5. Worn gears
    6. Rack and pinion
    7. Involute tooth shape

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Two

Tools and Equipment:

Machine drawings

CLASSROOM HOURS 5

EVALUATION (BBR-02)

Given a series of machine drawings, the student will identify and interpret the drawings in terms of appropriate terminology according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Bearing drawing
    1. Journal or sleeve bearing
    2. Plain bearing
j. Identifying bearing drawings
    1. Ball, roller and needle bearings
    2. Low friction bearings
    3. Races
    4. Thrust load
k. Pulley and belt drawings

Provide Practical Application On:

Identify and describe machine drawings.

TASK

BBR-03 Identifying hydraulic and pneumatic drawings

PERFORMANCE OBJECTIVE

Identify, read and interpret hydraulic and pneumatic drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Fluid systems
b. Pascal's Law
c. Multiplication of forces
d. Pistons and cylinders
e. Basic fluid components
    1. Reservoir
    2. Pump
    3. Piping
    4. Control valve
    5. Actuating unit
    6. Hydraulic and pneumatic system drawing symbols

Provide Practical Application On:

Read hydraulic and pneumatic drawings.

INSTRUCTIONAL MATERIALS

Textbooks:

Pease, Basic Fluid Power

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Three

Tools and Equipment:

Hydraulic and pneumatic system schematics

CLASSROOM HOURS 5

EVALUATION (BBR-03)

Given a series of hydraulic and pneumatic drawings, the student will identify, read and interpret the drawings according to the instructor's specifications.

TASK

BBR-04 Using machine drawings in the maintenance of machinery and equipment

PERFORMANCE OBJECTIVE

Use machine drawings in the maintenance of machinery and equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Production machines and drawings
    1. Cutting machines
    2. Bending and forming machines
    3. Molding and casting machines
    4. Rotary action
    5. Reciprocating action
b. Power sources for machines
    1. Hydraulic
    2. Pneumatic
    3. Lathe
    4. Grinder
    5. Milling machine
    6. Arbor
c. Machine assembly and detail drawings
    1. Lubrication and maintenance drawings
    2. Parts list
d. Assembling drawing applications
e. Use of models
f. Equipment pictorials
g. Exploded pictorial drawings
h. Manufacturing illustrations and maintenance illustrations
i. Using drawings in maintenance of machinery and equipment
    1. Prevention
    2. Service manuals

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Four

Tools and Equipment:

Machine drawings

CLASSROOM HOURS 20

EVALUATION (BBR-04)

Given a machine with a maintenance requirement and a machine drawing, the student will read and interpret the machine drawing and recommend necessary maintenance for the machine according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Interpret machine drawings to plan machine maintenance.

TASK

BBR-05 Reading building drawings

PERFORMANCE OBJECTIVE

Read and interpret building drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How blueprints can make a job easier
b. Building and building sites
c. Symbols and conventions on drawings
d. Plat plan
   1. Boundaries, bearings, distances
   2. Degrees and minutes
e. Site plan
f. Building drawings
g. Working drawings
   1. Structural drawings
   2. Elevation drawings
   3. Flow diagram

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Five

Tools and Equipment:

Building drawings

CLASSROOM HOURS 5

EVALUATION (BBR-05)

Given a building drawing, the student will read and interpret the drawing according to the instructor's specifications.

TASK

BBR-06 Reading electrical drawings

PERFORMANCE OBJECTIVE

Read and interpret electrical drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wiring diagram applications
b. Using power distribution diagrams
   1. Loads
   2. Circuit breakers or fuses
c. Power distribution circuits
   1. Primary transformer winding
   2. Secondary transformer winding
   3. Neutral or identified conductor
   4. Hot conductor
d. Electrical drawings
   1. Plot plans
   2. Riser drawings
   3. Single line wiring diagram
   4. Title blocks
e. Electrical blueprint application
f. Plant wiring requirements
   1. Conduit
   2. Flexible arm and wiring or BX cable
   3. Explosion proof wiring
g. Safety

Provide Practical Application On:

Read and interpret electrical blueprints.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Six

Tools and Equipment:

Electrical blueprints

CLASSROOM HOURS 5

EVALUATION (BBR-06)

Given an electrical blueprint, the student will read and interpret the drawing according to the instructor's specifications.

TASK

BBR-07 Reading pipe system drawings

PERFORMANCE OBJECTIVE

Read and interpret pipe system drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Application of piping diagrams
  - 1. Single-line piping diagram
  - 2. Riser diagrams
- b. Purpose of piping systems
  - 1. Distribution
  - 2. Waste
- c. Piping materials
  - 1. Copper
  - 2. Iron and steel
- d. Pipe fittings
  - 1. Street elbow
  - 2. Coupling
  - 3. Plug
- e. Use of valves
  - 1. Dreck valves
  - 2. Direction of flow
- f. Pipe system drawings
  - 1. Scale layouts and single-line layouts
  - 2. Orthographic projections
  - 3. Elevation and plan
  - 4. Developed diagrammatic layouts
- g. Pictorial piping diagrams
- h. Architectural piping diagrams

Provide Practical Application On:

Read and interpret pipe system drawings.

INSTRUCTIONAL MATERIALS

Textbooks:

Pease, Basic Fluid Power

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Seven

Tools and Equipment:

Pipe system diagrams

CLASSROOM HOURS 4

EVALUATION (BBR-07)

Given a pipe system drawing, the student will read and interpret the drawing according to the instructor's specifications.

TASK

BBR-08 Reading sheet metal drawings

PERFORMANCE OBJECTIVE

Read and interpret sheet metal drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of sheet metal
   1. Galvanized
   2. Aluminum
b. Duct system drawings
c. Ventilation system components and symbols
   1. Ducts
   2. Duct sections
   3. Direction of flow
   4. Supply outlets
   5. Return or exhaust grills
   6. Access doors
   7. Dampers
   8. Dual duct system
   9. Through ceiling type diffusers
   10. Sill aerators
d. Forming sheet metal parts
   1. Developments
   2. Parallel developments
   3. Truncated cylinders
   4. Radial developments
   5. Truncated pyramids
   6. Triangulated developments
e. Sheet metal connection drawings

Provide Practical Application On:

Read and interpret sheet metal drawings.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Walker, Modern Metal-Working

A/Vs:

Career Aids, Inc.,
"Sheet Metal Work Explained"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Eight

Tools and Equipment:

Sheet metal drawings

CLASSROOM HOURS 5

EVALUATION (BBR-08)

Given a sheet metal drawing, the student will read and interpret the drawing according to the instructor's specifications.

TASK

BBR-09 Using shop math to interpret blueprints

PERFORMANCE OBJECTIVE

Use shop math to interpret blueprints.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating dimensions on blueprints
    1. Straight line measurement
    2. Fractions
    3. Decimals
b. Addition
c. Subtraction
d. Multiplication
e. Diyisions
f. Adding and subtracting decimals
g. Multiplying decimals
h. Adding and subtracting fractions
    1. Numerator
    2. Denominator
    3. Common denominator
    4. Mixed numbers
    5. Proper and improper fractions
i. Multiplying fractions
j. Dividing fractions
k. Angles
    1. Degrees, minutes and seconds
    2. Adjacent angles
    3. Opposite angles
l. Areas of rectangles
m. Radius

Provide Practical Application On:

Calculate dimensions on blueprints.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Mathematics for the Shop
b. Hobar, Practical Problems in Math Series

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Nine

Tools and Equipment:

Blueprints

CLASSROOM HOURS 20

EVALUATION (BBR-09)

Given a blueprint with dimensions which are not labeled, the student will calculate the dimensions according to the instructor's specifications. The student will also read and interpret the blueprint.

TASK

BBR-10 Sketching schematic diagrams

PERFORMANCE OBJECTIVE

Sketch a schematic diagram.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Visualizing the drawing
b. Applying sketching techniques
    1. Dimensions
    2. Written descriptions
c. Orthographic sketching
d. Pictorial sketching
e. Isometric sketching
f. Oblique sketching
    1. Cabinet sketching
    2. Cavalier sketching
g. Perspective sketching
h. Shading
    1. Continuous tone
    2. Line tone
i. Sketching a schematic diagram

Provide Practical Application On:

Draw/sketch a schematic diagram from specifications.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Willis, Blueprint Reading for Commercial Construction
b. Jensen and Hines, Interpreting Engineering Drawings

A/Vs:

Career Aids, Inc.,"Drafting and Blueprint Reading Series"

Student Manuals:

Plant Engineering Training Systems, Basic Blueprint Reading, Lesson Ten

Tools and Equipment:

a. Pencils
b. Drawing media

CLASSROOM HOURS

10

EVALUATION (BBR-10)

Given specifications and necessary supplies, the student will sketch a schematic diagram according to the instructor's specifications.

TASK

RSS-01 Identifying types of schematics used in plant engineering

PERFORMANCE OBJECTIVE

Identify types of schematics used in plant engineering.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of symbols
b. Schematic
c. Why plant maintenance engineers must be able to read schematics
d. Why schematics are used
e. Electrical diagrams
f. Piping diagrams
g. Fluid power diagrams
h. Using schematics in plant maintenance
i. Cutaway diagram
j. Pictorial diagram
k. Combination diagram

Provide Practical Application On:

a. Interpret a schematic.
b. Interpret a piping diagram.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Morrow, Plant Engineering Handbook
b. Smith, Electricity for Refrigeration, Heating and Air Conditioning

A/Vs:

Career Aids, Inc., "Basic Electricity and Electronics Explained"

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson One

Tools and Equipment:

a. Schematic diagrams
b. Piping diagrams

CLASSROOM HOURS 15

EVALUATION (RSS-01)

Given a schematic diagram and a piping diagram, the student will correctly identify basic symbols and read the diagram according to the instructor's specifications.

TASK

RSS-02 Identifying the symbols on electrical, piping and fluid power diagrams

PERFORMANCE OBJECTIVE

Identify the symbols used in electrical, piping and fluid power diagrams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The meaning of lines
   1. Electrical
   2. Piping
   3. Fluid power
b. Legend
c. Kinds of lines
d. Symbols as opposed to pictures
e. Linking the symbols to form a system
f. Determining the type of system from a diagram
g. How the elements connect in a system

Provide Practical Application On:

Determine the type of system from a diagram.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Morrow, Plant Engineering Handbook
b. Bobbs-Merrill, Industrial Electronic Systems
c. Howard W. Sams & Co., Inc., Collected Basic Circuits

A/Vs:

Career Aids, Inc., "Basic Electricity and Electronics Explained"

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Two

Tools and Equipment:

Electrical, piping and fluid power diagrams

CLASSROOM HOURS

30

EVALUATION (RSS-02)

Given an electrical, piping or fluid power diagram, the student will correctly identify the type of system diagrammed and identify the purpose of each symbol used. All diagram identifications should be within the instructor's specifications.

TASK

RSS-03 Identifying guidelines for reading schematics

PERFORMANCE OBJECTIVE

Identify guidelines for reading schematics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Look for the flows in the system.
  - 1. Piping flows
  - 2. Electrical flows, AC, DC
- b. Looking for clues
  - 1. Check valves
  - 2. Gage symbols
  - 3. Combination symbols
- c. Reading diagrams carefully
- d. Troubleshooting guidelines
  - 1. Get a group on the whole system.
  - 2. Identify the problem.
  - 3. Determine possible causes for the problem.
  - 4. Study a local area of the schematic.

Provide Practical Application On:

Look at diagrams and determine direction of flow.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Smith
- b. Morrow, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Three

Tools and Equipment:

Electrical, piping and fluid power diagrams

CLASSROOM HOURS 5

EVALUATION (RSS-03)

Given an electrical, piping or fluid power diagram, the student will interpret the diagram and correctly identify the direction of the flow according to the instructor's specifications.

TASK

RSS-04 Identifying electrical symbols

PERFORMANCE OBJECTIVE

Identify electrical symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Importance of following troubleshooting procedure
b. Wires
   1. Connections
   2. Crossings
c. Switches
   1. Disconnect
   2. Push button
d. Power sources
   1. Positive terminal
   2. Negative terminal
e. Electrical loads
f. Coils, inductors and transformers
g. Fuses, circuit breakers and grounds
h. Contacts and resistors
   1. Contact N.O.; N.C.
   2. Fixed resistors
   3. Adjustable resistors, rheostats, potentiometers
i. Connecting symbols

Provide Practical Application On:

Identify electrical symbols on a schematic.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Loper and Ahr, Electricity and Electronics
b. Delmar, Electronics, Electricity, Electro-Mechanical Technology
c. Howard W. Sams & Co., Inc., How to Read a Schematic Diagram

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Four

Tools and Equipment:

Electrical schematics

CLASSROOM HOURS

5

EVALUATION (RSS-04)

Given a schematic diagram, the student will identify electrical symbols and describe their purpose in the schematic. The completed task should be in accordance with the instructor's specifications.

TASK

RSS-05 Reading electrical diagrams

PERFORMANCE OBJECTIVE

Read an electrical diagram.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical schematic diagrams
b. Wiring diagrams
c. Wires shown as lines or color coded
d. Wiring diagram and schematic compared
e. Components
  1. Power source
  2. Load
  3. Wires
f. Switches
g. Series and parallel circuits
h. A systems approach to reading electrical diagrams
i. Making an industrial schematic

Provide Practical Application On:

Read an electrical diagram to trace a component of a system.

INSTRUCTIONAL MATERIALS

Textbooks:

Howard W. Sams & Co., Inc., How to Read Schematic Diagrams

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Five

Tools and Equipment:

Electrical diagram and system

CLASSROOM HOURS 10

EVALUATION (RSS-05)

Given an electrical diagram, the student will trace the wiring of the circuit to a specified component. The completed task must meet the instructor's requirements.

TASK

RSS-06 Identifying piping symbols

PERFORMANCE OBJECTIVE

Identify piping symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Pipes transfer fluids and gases
- b. Piping diagrams
  - 1. Controlled flow valves
  - 2. Importance of piping systems
  - 3. Methods of drawing piping diagrams
- c. Differing views
  - 1. Orthographic projection
  - 2. Isometric
- d. Types of joints
  - 1. Screwed
  - 2. Welded
  - 3. Flanged
  - 4. Bell-and-spigot
  - 5. Soldered
- e. Fittings
  - 1. Change direction of flow.
  - 2. Change the size of the pipe.
  - 3. Provide branch connections.
  - 4. Close a pipe line.

Provide Practical Application On:

Identify symbols on a piping diagram.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Morrow, Maintenance Engineering Handbook
- b. Willis, Blueprint Reading for Commercial Construction

A/Vs:

Career Aids, Inc., "Drafting and Blueprint Reading"

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Six

Tools and Equipment:

Piping diagrams

CLASSROOM HOURS

5

EVALUATION (RSS-06)

Given a piping diagram, the student will correctly identify the symbols according to the instructor's specifications.

TASK

RSS-07 Reading piping schematics

PERFORMANCE OBJECTIVE

Read a piping schematic.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Piping systems
   1. Joints
   2. Fittings
   3. Valves
   4. Gate valve
   5. Plug valve
   6. Globe valve
   7. Check valve

b. Reading a single schematic

Provide Practical Application On:

Read a simple piping schematic.

INSTRUCTIONAL MATERIALS

Textbooks:

Willis, Blueprint Reading for Commercial Construction

Student Manuals:

a. Plant Engineering Training System, Reading Schematics and Symbols, Lesson Seven
b. Oregon, Symbols
c. Oregon, Basic Symbols

Tools and Equipment:

Piping schematics

CLASSROOM HOURS 10

EVALUATION (RSS-07)

Given a simple schematic of a piping system, the student will read and interpret the schematic according to the instructor's specifications.

TASK

RSS-08 Identifying fluid power symbols

PERFORMANCE OBJECTIVE

Identify fluid power symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of a system
   1. Pump
   2. Fluid
   3. Piping
b. Pneumatics
c. Hydraulics
d. Reservoir or receiver
e. Pump or compressor
   1. Fixed displacement pump
   2. Variable displacement pump
f. Actuator
   1. Linear actuator
   2. Single or double acting cylinders
   3. Differential cylinders
   4. Rotary actuator
   5. Fixed or variable displacement
g. Valves
   1. Power or directional
   2. Mechanical or electrical
h. Describing valves by
   1. The number of ways fluids enter or leave the valve
   2. The number of positions the valve can operate
i. Tubing or piping

Prcvide Practical Application On:

Identify symbols on a fluid power schematic.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Howard W. Sams & Co., Inc., "Fluid Power" (transparencies)

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Eight

Tools and Equipment:

Fluid power schematics

CLASSROOM HOURS

5

EVALUATION (RSS-08)

Given a fluid power schematic, the student will correctly identify symbols on the schematic.

TASK

RSS-09 Reading fluid power schematics

PERFORMANCE OBJECTIVE

Read fluid power schematics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Composite symbols
b. Tracing fluid power circuits
c. Hydraulic circuits
d. Pneumatic circuits
e. Types of fluid power diagrams
    1. Pictorial
    2. Cutaway
    3. Schematic

Provide Practical Application On:

Read a simple fluid power schematic.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training System, Reading Schematics and Symbols, Lesson Nine

Tools and Equipment:

Fluid power schematics

CLASSROOM HOURS

5

EVALUATION (RSS-09)

Given a fluid power schematic, the student will correctly read and interpret symbols and direction of flow on the schematic.

TASK

RSS-10 Identifying welding symbols

PERFORMANCE OBJECTIVE

Identify welding symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Welding processes
  - 1. Pressure welding
  - 2. Non-pressure welding
- b. Three methods of fusion welding
  - 1. Arc welding
  - 2. Gas welding
  - 3. Resistance welding
- c. Assembled welding symbol
  - 1. Reference line
  - 2. Arrow
  - 3. Basic weld symbol
  - 4. Dimensions and other data
  - 5. Supplementary symbols
  - 6. Finish symbol
  - 7. The tail
  - 8. Specifications, processes and other references
- d. Location of the weld
- e. Symbols
  - 1. Weld-all-around
  - 2. Spot, seam, flash
  - 3. Break in arrow of bevel and J-groove
  - 4. Combination symbols
- f. Special weld designations
  - 1. Cross section view on detail drawing
  - 2. Field weld symbol

Provide Practical Application On:

Identify and interpret welding symbols.

INSTRUCTIONAL MATERIALS

Textbooks:

Griffin and Roden, Welding Processes

A/Vs:

Hobar, "Blueprint Reading for Welders"

Student Manuals:

Plant Engineering Training Systems, Reading Schematics and Symbols, Lesson Ten

Tools and Equipment:

Welding diagram

CLASSROOM HOURS

6

EVALUATION (RSS-10)

Given a welding symbol, the student will identify and interpret the symbol according to the instructor's specifications.

TASK

MM-01 Identifying the physical structure of metals

PERFORMANCE OBJECTIVE

Identify the physical structure of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of a metal
    1. Lustrous appearance
    2. Conductivity
    3. Number of metals in existence
b. Metallurgy
    1. Ores
    2. Chemical metallurgy
    3. Physical metallurgy
c. Properties of metals
    1. Strength
    2. Malleability
    3. Ductility
    4. Toughness
    5. Elasticity
    6. Ferromagnetic
    7. Thermocouple
d. Melting point of metals
    1. Definition
    2. Latent heat of fusion
e. Arrangement of atoms in metals
    1. Space lattice or geometric crystal structure
    2. Hexagonal close packed space lattice
f. Crystal formation
g. Composition of alloys
h. Nonferrous alloys
i. Cadmium
j. Cobalt
k. How metals are cast
l. Metal working
m. How metals are joined

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson One

CLASSROOM HOURS 2

EVALUATION (MM-01)

Given a metal, the student will correctly identify its physical structure in terms of appearance, conductivity, malleability and melting point.

TASK

MM-02 Identifying properties of metals

PERFORMANCE OBJECTIVE

Identify properties of metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mechanical properties
    1. Hardness
    2. Ductility
    3. Machinability
    4. Tensile strength
b. Stress
c. Kinds of stress
    1. Tension
    2. Compression
    3. Shear
d. Elasticity
    1. Elastic limit
    2. Ultimate breaking strength
e. Strain
f. Metal fatigue
f. Causes of failure
    1. Elastic breakdown
    2. Creep failures
h. Useable strength of metal
i. Heat and temperature
    1. Friction
    2. Motion of molecules
    3. Transfer of heat
    4. Heat and cold
j. Expansion of metals
k. Density
l. Specific gravity

Provide Demonstration On:

Figuring tensile strength

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Two

CLASSROOM HOURS

2

EVALUATION (MM-02)

Given a metal, the student will correctly identify its basic properties and figure tensile strength for a specified area and force.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Figure tensile strength.

TASK

MM-03 Identifying methods of heat treatment

PERFORMANCE OBJECTIVE

Identify methods used to heat treat metals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Metallurgy and heat treatment
b. Principles of heat treating
c. Equilibrium diagrams
d. Transformation of temperatures
e. Iron-carbon phase diagram
    1. Liquidous line
    2. Solidous line
    3. Eutectic point
    4. Austenite
    5. Delta ferrite
    6. Alpha ferrite
    7. Eutectoid
    8. Pearlite
f. Effects of heating, holding, cooling
g. Isothermal transformation
    1. S-curve or TTT diagram
    2. Pearlite
    3. Bainite
    4. Martensite
h. Heat treating ferrous metals
    1. Hardening
    2. Tempering
    3. Annealing
    4. Normalizing
    5. Spheroidizing
    6. Casehardening

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Three

CLASSROOM HOURS 3

EVALUATION (MM-03)

Given a specified heat treatment process for metals, the student will identify and describe the process in terms of the properties of the metal.

TASK

MM-04 Identifying metal manufacturing processes

PERFORMANCE OBJECTIVE

Identify metal manufacturing processes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of casting
    1. Sand
    2. Centrifugal
    3. Permanent-mold
    4. Die
b. Permanent-mold casting
c. Centrifugal casting
    1. Application
    2. Procedure
d. Die casting
    1. Hot chamber
    2. Cold chamber
e. Die forging
f. Extrusion
    1. Procedure
    2. Advantages
g. Cold forging steel
    1. Upsetting or heading
    2. Header
    3. Applications
h. Processing metal powders
    1. Electroforming
    2. Powder metallurgy
    3. Metal powder products
i. Stretching, shearing, bending
j. Wire drawing
    1. Material used
    2. Pickling
    3. Sulling

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

A/Vs:

Career Aids, Inc., "Foundry Work"

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Four

CLASSROOM HOURS 2

EVALUATION (MM-04)

Given a specified metal manufacturing process, the student will identify the process, describe the steps in the process and identify the purpose of the process in terms of products.

TASK

MM-05 Identifying iron manufacturing processes

PERFORMANCE OBJECTIVE

Identify processes used to produce iron.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Iron ore
b. Making pig iron
   1. Pigs
   2. Pig molds
   3. Smelting
   4. Reduction
   5. Charging the blast furnace
c. Making cast iron
   1. Categories of iron-carbon alloys
   2. Elements in cast iron
   3. Advantages of cast iron
   4. Cupola
   5. Cementite
d. Gray cast iron
   1. Characteristics
   2. Applications
e. White cast iron
   1. Characteristics
   2. Applications
f. Malleable cast iron
   1. Characteristics
   2. Applications
g. Ductile cast iron
   1. Characteristics
   2. Applications
h. Producing steel from iron
   1. Open-hearth process
   2. The bessemer process
   3. Basic oxygen process
   4. Electric furnace process

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Five

CLASSROOM HOURS 2

EVALUATION (MM-05)

Given specifications for a type of iron and steel, the student will identify and describe the processes used to produce the iron and steel. The student will identify the characteristics and applications of the metal. The completed tasks must be in accordance with the instructor's specifications.

TASK

MM-06 Identifying processes used to produce steel

PERFORMANCE OBJECTIVE

Identify processes used to produce steel.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Carbon steels
  1. Points
  2. Low carbon steel
  3. Medium carbon steel
  4. High carbon steel
b. Rolling steel
  1. Ingots
  2. Blooms, billets on slabs
c. Steel forms
  1. Plate
  2. Sheet
  3. Strip
  4. Bars
  5. Hot-rolled
  6. Cold-drawn
  7. Cast
d. Hot-rolled steel sheet
  1. Commercial quality (CQ)
  2. Drawing quality (DQ)
  3. Physical quality (PQ)
e. Cold-rolled steel sheets
f. Hot-rolled carbon steel strips
g. Cold-rolled carbon steel strips
h. Carbon steel plates
i. Carbon steel bars
j. Structural steel
k. Constructional grade and tool steels
l. Stainless steel
  1. Austenitic
  2. Ferritic
  3. Martensitic

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Six

CLASSROOM HOURS

2

EVALUATION (MM-06)

Given a piece of steel which is coded, the student will identify the code, describe the process used to produce the steel and identify the application of the steel according to instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Alloy steels
n. Steel classification
    1. SAE
    2. AISI
o. Steel color codes

Provide Demonstration On:

Identify steel codes.

Provide Practical Application On:

Identify the type of steel given and its code.

TASK

MM-07 Identifying processes used to produce aluminum

PERFORMANCE OBJECTIVE

Identify processes used to produce aluminum.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of aluminum
   1. Low density
   2. High strength
   3. Electrical conductor (EC) grade
   4. Easy to fabricate
   5. Non-magnetic and non-sparking
b. Production of aluminum
c. Aluminum based alloys
   1. Wrought grades
   2. Casting grades
d. Wrought aluminum grades
   1. Aluminum association designation system
   2. Temper designation
e. Aluminum casting grades
   1. Aluminum association system
   2. Codes for heat-treatable casting alloys
f. Alloying elements
   1. Copper
   2. Silicon
   3. Magnesium
   4. Non-impurities
   5. Zinc, nickel and tin
g. Forming processes
   1. Forging
   2. Powder metallurgy
   3. Cladding
h. Anodizing
   1. Purpose
   2. Industrial applications

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Seven

Tools and Equipment:

a. Torch
b. Aluminum
c. Solder
d. Flux
e. Steel wool or emery cloth
f. Solvent

CLASSROOM HOURS 2

EVALUATION (MM-07)

Given a section of aluminum, the student will identify the type and describe the process used to produce it. Using this section of aluminum, the student will solder a joint. The completed task must meet the instructor's requirements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Joining aluminum
   1. Welding
   2. Brazing
   3. Soldering
   4. Soldering safety

Provide Demonstration On:

Soldering aluminum

Provide Practical Application On:

Solder two pipes of aluminum together.

TASK

MM-08 Identifying processes for the production of magnesium and titanium

PERFORMANCE OBJECTIVE

Identify the processes for the production of magnesium and titanium.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Production of magnesium
   1. Magnesium fluoride
   2. Magnesite
   3. Dolomite
   4. Carnallite
b. Extraction of magnesium
   1. Electrolytic method
   2. Carbothermic method
c. Alloying melting and refining magnesium
   1. Process
   2. Equipment
d. Alloying magnesium
e. Magnesium alloy designations
f. Magnesium casting alloys
   1. Magnesium-aluminum-manganese (AM)
   2. Magnesium-aluminum-zinc (AZ)
   3. Magnesium-rare earth-zirconium (EK, EZ and ZE)
   4. Magnesium-zinc-zirconium (ZK)
   5. Magnesium-thorium-zirconium (HK, HZ, and ZH)
g. Magnesium wrought alloys
h. Extrusion
i. Rolling
j. Forming
k. Machining
l. Magnesium fires and safety

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INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Eight

CLASSROOM HOURS 2

EVALUATION (MM-08)

Given a specification for magnesium, titanium or an alloy, the student will identify the metal, describe the process used to refine it and identify procedures used to join the metal. The completed task must meet the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Joining magnesium
    1. Welds, rivets, bolts or screws
    2. TIG welding and MIG welding
n. Titanium
    1. Processing
    2. Commercially pure titanium
    3. Uses of titanium

TASK

MM-09 Identifying processes used to produce copper

PERFORMANCE OBJECTIVE

Identify processes used to produce copper.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Producing copper
   1. Ores
   2. Separating ore
   3. Blister copper
   4. Anodes
   5. Cathodes
b. Copper alloys
   1. Silver
   2. Boron
   3. Lithium
c. Machinability ratings
   1. Adding lead
   2. Naval brass
   3. Red brass
d. Electrical conductivity
e. Corrosion resistance
f. Annealing copper
g. Brass
   1. Yellow (cartridge) brass
   2. Muntz metal
   3. Admiralty brass
   4. Bronze
h. Phosphor bronze alloy
i. Nickel silver
j. Aluminum bronze
k. Other bronzes
   1. Manganese
   2. Silicon
   3. Bull bronze
   4. Nickel bronze
l. Beryllium Copper
m. Cupro-nickel
n. Copper-alloy casting

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Nine

CLASSROOM HOURS

2

EVALUATION (MM-09)

Given specifications for copper, the student will identify the type of copper or alloy and describe the process used to produce the metal according to the instructor's specifications.

TASK

MM-10 Identifying processes used to produce lead, nickel, tin and zinc

PERFORMANCE OBJECTIVE

Identify processes used to produce lead, nickel, tin and zinc.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Properties of lead
   1. Corrosion resistance
   2. Dense
   3. Soft
   4. Low melting point
   5. Color
b. Production of lead
c. Available forms of lead
   1. Pig
   2. Ingot
   3. Piping and tubing
d. Forming and fabricating lead
e. Methods of joining lead
   1. Soldering
   2. Welding (burning)
f. Producing nickel
   1. Uses of nickel
   2. Alloys
g. Properties of tin
   1. Brightness
   2. Corrosion resistance
   3. Low melting point
   4. Malleable
   5. Other Properties
h. Uses of tin in industry
i. Tin plate
j. Tin alloys
k. Solders
l. Babbitt
m. Bronze
n. Zinc
   1. Producing zinc
   2. Zinc coatings
   3. Zinc paints
   4. Zinc compounds
   5. Machining zinc

INSTRUCTIONAL MATERIALS

Textbooks:

a. Feirer, General Metals
b. Harold V. Johnson, Technical Metals

Student Manuals:

Plant Engineering Training Systems, Metal Materials, Lesson Ten

CLASSROOM HOURS 2

EVALUATION (MM-10)

Given specifications for lead, nickel, tin and zinc, the student will identify the processes used to produce the metal and describe its properties and applications according to the instructor's specifications.

TASK

NMM-01 Identifying non-metal materials

PERFORMANCE OBJECTIVE

Identify non-metal materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Classifying materials
   1. Solid
   2. Liquid
   3. Gas
   4. Kinetic energy

b. Properties of gases
   1. Standard temperature and pressure
   2. Intensity

c. Behavior of gases
   1. $P_1 V_1 = P_2 V_2$ (Boyle's Law)
   2. Changing a gas to a liquid

d. Properties of liquids
   1. Meniscus
   2. Viscosity
   3. Density
   4. Specific gravity
   5. Freezing point
   6. Vapor pressure
   7. Evaporation
   8. Condensation
   9. Boiling point
   10. Volatility
   11. Buoancy

e. Behavior of liquids at rest

f. Fluids in motion
   1. Streamline or laminar flow
   2. Turbulent flow
   3. Cavitiation

g. Solids
   1. Crystalline structures
   2. Melting point
   3. Amorphous materials

h. Mixed phases

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson One

CLASSROOM HOURS 2

EVALUATION (NMM-01)

Given specifications for a non-metal substance, the student will identify the substance in terms of its state of matter and describe its properties according to the instructor's specifications.

TASK

NMM-02 Identifying properties of plastics

PERFORMANCE OBJECTIVE

Identify properties of plastics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Nature of plastics
  - 1. Polymers
  - 2. Polymerization
  - 3. Resins
  - 4. Thermoplastics
  - 5. Thermosets
  - 6. Tradenames
- b. Processing and fabricating plastics
- c. Molding processes
  - 1. Injection molding
  - 2. Compression molding
  - 3. Transfer molding
  - 4. Blow molding
  - 5. Thermoforming
  - 6. Rotational molding
- d. Casting and foaming processes
  - 1. Expanded bead molding
  - 2. Foam molding
- e. Extrusion
  - 1. Blown film extrusion
  - 2. Wire extrusion coating
- f. Reinforced plastics
  - 1. Calendering
  - 2. Laminations
  - 3. Filament winding
- g. Machining plastics
  - 1. Sawing
  - 2. Drilling
  - 3. Cutting threads
  - 4. Grinding, sanding, buffing
  - 5. Metal inserts

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INSTRUCTIONAL MATERIALS

Textbooks:

- a. Schmidt, Basic Plastics
- b. Richardson, Modern Industrial Plastics

A/Vs:

Bobbs-Merrill, "Foam Molding", "Injection Molding", "Polymer Structure", "Reinforced Plastics", "Rotational Molding" and "Thermoforming"

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Two

CLASSROOM HOURS

2

EVALUATION (NMM-02)

Given specifications for a plastic material, the student will identify the type of plastic, the process used to produce it and its applications. The completed task must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Plastic assembly methods
    1. Processes
    2. Safety
i. Plastic welding
j. Patching with plastic
    1. Polyesters
    2. Epoxus

TASK

NMM-03 Identifying properties of rubber

PERFORMANCE OBJECTIVE

Identify properties of rubber.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Nature of rubber
   1. Latex
   2. Elasticity
   3. Resilience
   4. Elastomers
   5. Permanent set
   6. Impermeable

b. Rubber processing

c. Kinds of rubber
   1. Natural rubber
   2. SBR
   3. Butyl rubber
   4. Neoprene
   5. Polysulfide rubber
   6. Nitrile rubber
   7. Silicone rubber
   8. Fluorocarbon rubber

d. Groups of rubber
   1. Class R
   2. Class S
   3. Class T

e. Properties of rubber
   1. Electrical resistance
   2. Flame resistance
   3. Impermeability
   4. Resistance to heat or cold
   5. Oxidation

f. Rubber applications

g. Vulcanizing rubber

h. Foamed rubber
   1. Inert gas under pressure
   2. Blowing agent
   3. Whipped latex

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INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Three

CLASSROOM HOURS 2

EVALUATION (NMM-03)

Given specifications for a rubber application, the student will correctly identify the type of rubber, its properties and the process used to produce it.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Hoses and tubing
    1. Lining
    2. Reinforcement
    3. Cover
j. Tank linings
k. Conveyor and drive belts
l. Sheet rubber
m. Wire and cable insulation
n. Reclaiming rubber

TASK

NMM-04 Identifying properties and applications of carbon

PERFORMANCE OBJECTIVE

Identify properties and applications of carbon.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Carbon and graphite
   1. Forms of carbon
   2. Applications of carbon
   3. Forms of graphite
   4. Applications of graphite
   5. Production of graphite
   6. Charcoal
   7. Lamp black

b. Properties and characteristics of carbon and graphite
   1. Heat resistance
   2. Thermal shock resistance
   3. Heat and electrical conductivity
   4. Does not melt
   5. Inert to chemical action
   6. Lubricates under special conditions

c. Carbon in batteries and resistors
   1. Carbon rods in batteries
   2. Carbon piles for current control
   3. Construction of a resistor

d. Carbon electrodes for lighting and welding

e. Refractory (furnace) applications of carbon

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INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Four

CLASSROOM HOURS	2

EVALUATION (NMM-04)

Given specifications for a carbon or graphite material, the student will correctly identify their applications and describe the process used to produce them.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Carbon brushes
g. Carbon brush problems
    1. Noisy operation
    2. Burned spots
    3. Excessive surface film build-up
    4. Oil on the commutator
h. Carbon brush grades
i. Industrial diamonds
j. Fabricating carbon and graphite products
    1. Powder base
    2. Binder material such as pitch, tar, resins
    3. Heat
k. Mechanical parts and seals
l. Carbon bearings
m. Pump and valve parts
n. Chemical application

TASK

NMM-05 Identifying industrial chemicals and their applications

PERFORMANCE OBJECTIVE

Identify industrial chemicals and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Characteristics of chemicals
  - 1. Acid
  - 2. Neutral
  - 3. Alkaline
  - 4. pH scale
  - 5. Safety
- b. Soaps and detergents
  - 1. Tallow
  - 2. Detergents - surfactants
  - 3. Biodegradable detergents
- c. Alkali cleansers
- d. Solvents
  - 1. Chlorinated solvents
  - 2. Thinners
- e. Acids
  - 1. Safety
  - 2. Muriatic
  - 3. Nitric
  - 4. Phosphoric
  - 5. Sulfamic
- f. Industrial gases
  - 1. Nitrogen
  - 2. Oxygen
  - 3. Chlorine
  - 4. Carbon dioxide
  - 5. Ammonia
  - 6. Hydrogen
  - 7. Acetylene
- g. Packaged chemicals
  - 1. Types
  - 2. Applications
- h. Aerosols

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Five

CLASSROOM HOURS 2

EVALUATION (NMM-05)

Given a specified industrial chemical, the student will identify the chemical and describe its applications according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Lubricants and oils
   1. Graphite
   2. Molybdenum

j. Refrigerants and water treatments
   1. Ammonia
   2. Chlorinated and hydrocarbons florinated
   3. Safety

k. Welding and plating aids

l. Fuels

m. Fire fighting chemicals
   1. Class A
   2. Class B
   3. Class C
   4. Class D

n. Protective equipment
   1. Clothing
   2. Safety instruments

TASK

NMM-06 Indentifying paints, coatings and their applications

PERFORMANCE OBJECTIVE

Identify paints, coatings and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Applications
  1. Wood protection
  2. Steel protection
b. Substrates
  1. Fabric
  2. Wood
  3. Metal surfaces
c. Pigments and vehicles
  1. Paint
  2. Thinner
  3. Water emulsion paints
  4. Acrylic and polyvinyl paints
d. Common interior paints
  1. Ester grim
  2. Alkyl
  3. Phenolic
  4. Epoxy
  5. Silicone
  6. Latex
  7. Synthetic rubber
e. Solvent safety
  1. Ventilation
  2. Skin contact
  3. Flame
  4. Personal injury and damage to equipment
f. Primer selection
  1. Substrate material
  2. Surface condition
  3. Type of finish to be applied
  4. Cathodic protection
g. Surface coating selection
  1. Substrate
  2. Surface conditions

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Six

Tools and Equipment:

a. Paints
b. Primers
c. Brushes
d. Rollers
e. Sprayers

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CLASSROOM HOURS

2

EVALUATION (NMM-06)

Given a material to paint, the student will select a primer, a surface coating and a method of application. The student will identify and observe all safety precautions. Tasks must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    3. Select coating
    4. Method of application
    5. Prepare surface
h. Surface preparation
    1. Wood
    2. Metal
    3. Masonry
i. Methods of application
    1. Brush
    2. Roller
    3. Spraying
    4. Dip
j. Zinc coating
k. Using colors
l. Speciality coatings
m. Paint terminology

Provide Demonstration On:

a. Selecting a primer
b. Selecting a surface coating
c. Selecting a method of application

Provide Practical Application On:

Select a primer, surface coating and method of application to paint a given surface.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. Wire brush
g. Sander
h. Thinner
i. Paint stirring rod or paddle

TASK

NMM-07 Identifying insulating materials and their applications

PERFORMANCE OBJECTIVE

Identify insulating materials and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How insulation works
b. Heat transfer
    1. Conduction
    2. Convection
    3. Radiation
c. Thermal insulating materials
d. Roll and batt insulation
e. Loose fill insulation
f. Low density insulation applications
g. Special insulation for extreme temperatures
h. Accoustical insulation
i. Sound absorbing materials
j. Vapor barriers
    1. Flame resistant jacket
    2. Low pressure or universal jacket
    3. Coatings
k. Electrical insulation
l. Fire barriers

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-Metal Materials Lesson Seven

CLASSROOM HOURS 2

EVALUATION (NMM-07)

Given an application which requires insulation, the student will accurately identify an insulator and describe its application.

TASK

NMM-08 Identifying properties and applications of construction materials

PERFORMANCE OBJECTIVE

Identify properties and applications of construction materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inspection of construction materials
b. Concrete
   1. Applications
   2. Hydration
   3. Types of cement
   4. Aggregates
c. Mixing
d. Defects
   1. Spalling
   2. Crazing
   3. Dusting
e. Stain removal
f. Patching and repairs
g. Masonry products
   1. Concrete masonry
   2. Concrete block
h. Bricks
   1. Face brick
   2. Building a common brick
   3. ASTM grades
i. Mortar
   1. ASTM classifications
   2. Repointing
j. Wallboard
   1. Gypsum wall or drywall
   2. Gypsum backing board
k. Wallboard repairs
l. Plaster
   1. Plaster of paris
   2. Hard-wall plaster
   3. Hard-finish plaster
   4. Special plaster
m. Glass
   1. Glass block
   2. Plastic glazing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dezettel, Masons and Builders Library
b. Smith, Materials of Construction

A/Vs:

DCA Educational Products, "Brick and Stone Masonry"

Student Manuals:

Plant Engineering Training Materials, Non-metal Materials, Lesson Eight

CLASSROOM HOURS 2

EVALUATION (NMM-08)

Given specifications for an industrial construction application, the student will accurately identify all the materials to be used and describe their properties.

TASK

NMM-09 Identifying properties and applications of wood

PERFORMANCE OBJECTIVE

Identify properties and applications of wood.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lumber industry
    1. Headrig
    2. Edger
    3. Kilns
b. Wood properties
    1. Hardwoods
    2. Softwoods
    3. Lignin
c. Wood grades
    1. Select
    2. Common
d. Hardwood grades
    1. Firsts
    2. Seconds
    3. Sweet
    4. Common
e. Wood defects
    1. Knots
    2. Checks
    3. Splits
    4. Warp
    5. Crown
f. Lumber measurements
    1. Running or lineal feet
    2. Board feet
g. Plywood
    1. Veneer
    2. Exterior grade
    3. Interior grade
h. Choosing a wood
i. Wood frame construction
j. Wooden stains
    1. Rise
    2. Run
    3. Treads
    4. Risers
    5. Stringers

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

A/Vs:

Hobar, "Wood Technology"

Student Manuals:

Plant Engineering Training Systems, Non-metal Materials, Lesson Nine

CLASSROOM HOURS 2

EVALUATION (NMM-09)

Given specifications for a job, the student will accurately select the appropriate type of lumber and the proper number of board feet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. Wood joints
l. Preservation and protection of wood
    1. Fillers or sealers
    2. Stains
m. Industrial applications
    1. Tanks and vats
    2. Ladders
    3. Stairs
    4. Decks and floors
    5. Scaffolding
n. Fasteners
    1. Glues
    2. Adhesives
    3. Nails
    4. Screws

Provide Demonstration On:

Selecting appropriate type and quantity of wood

Provide Practical Application On:

Select the appropriate wood and the proper number of board feet.

TASK

NMM-10 Identifying adhesives and tapes

PERFORMANCE OBJECTIVE

Identify adhesives and tapes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Adhesives
    1. Assembly time
    2. Bond
    3. Cure
    4. Dry
    5. Harden
    6. Joint
    7. Pot life
    8. Set
    9. Shelf life
    10. Tuck
    11. Working time
b. General characteristics
    1. Liquids
    2. Pastes
    3. Mastic
    4. Two-part adhesives
    5. Thermosetting adhesives
c. Animal glues
d. Casein glues
e. Vegetable glues
f. Synthetic resin glues
g. Repairs with plastic resin adhesives
h. Plastic welding
i. Acrylic based adhesives
j. Special adhesives
    1. Structural adhesives
    2. Anaerobic adhesives
k. Tapes
    1. Masking tape
    2. Duct-seal tape
    3. High-temperature tape
    4. Freezer tape
    5. Double-coated tape
    6. Heat-shrikable tape
    7. Foam-backed tape

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith, Materials of Construction

Student Manuals:

Plant Engineering Training Systems, Non-Metal Materials, Lesson Ten

CLASSROOM HOURS 2

EVALUATION (NMM-10)

Given a material that requires bonding, the student will select the appropriate adhesive or tape and describe the process which completes the bond. The completed task must be in compliance with the instructor's specifications.

INSTRUCTIONAL MATERIALS

Provide Demonstration On:

Applying adhesive and tape

Provide Practical Application On:

Select an adhesive or tape and apply it for a given job.

TASK

T-01 Identifying and using basic measuring tools

PERFORMANCE OBJECTIVE

Identify basic measuring tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Classifying measuring tools
   1. Linear measurement
   2. Angular measurement
   3. Transferring measurements
b. Rules and tapes
   1. Steel rule
   2. Folding rulers and tapes
   3. Taking measurements
c. Calipers
   1. Inside diameter
   2. Outside diameter
   3. Slide diameter
d. Micrometers
e. Squares

Provide Demonstration On:

Procedure for using a micrometer

Provide Practical Application On:

Use the following tools to make measurements:
1. Calipers
2. Micrometers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dover Publications, Tools and Their Uses
b. Hinrichs, Measuring

A/Vs:

a. Hobar, "Micrometers Calipers and Gages" and "Reading the Micrometers"
b. DCA Educational Products, "Precision Products"

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson One

Tools and Equipment:

a. Several types of calipers
b. Several types of micrometers
c. Items to measure

CLASSROOM HOURS

6

EVALUATION (T-01)

Given a measuring tool and an assigned measurement, the student will accurately use the tool and make the measurement. The measurement must be in compliance with the industry's standards.

TASK

T-02 Identifying and using wrenches and screwdrivers

PERFORMANCE OBJECTIVE

Identify and use wrenches and screwdrivers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wrenches
   1. Materials
   2. Uses
   3. Tolerance
b. Types of wrenches
   1. Open-end
   2. Box-end
   3. Combination
   4. Socket, socket handles
   5. Torque wrenches
   6. Socket head, Allen wrenches
c. Using wrenches
d. Screwdrivers
   1. Types of screwdrivers
   2. Dressing the blade
   3. Driving and drawing a screw
   4. Care, use and screwdriver safety

Provide Demonstration On:

a. Proper use of a torque wrench
b. Dressing the blade of a screwdriver

Provide Practical Application On:

a. Using several types of wrenches
b. Using several types of screwdrivers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dover Publications, Tools and Their Uses
b. Hobar, Screwdrivers

A/Vs:

a. Hobar, "Screwdrivers"
b. DCA, "Screwdrivers"

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Two

Tools and Equipment:

a. Assortment of wrenches
b. Assortment of screwdrivers

CLASSROOM HOURS 6

EVALUATION (T-02)

Given a job which requires the use of wrenches, torque wrenches and screwdrivers, the student will select the appropriate tools and use them according to correct and safe procedures.

TASK

T-03 Identifying and using pipefitting tools

PERFORMANCE OBJECTIVE

Identify and use pipefitting tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of pipe
b. Pipe wrenches
    1. Straight
    2. Stillson
c. How to use pipe wrenches
d. Compound cleverage wrench
e. Strap wrench
f. Chain pipe wrench
g. Cutting pipe
h. Pipe vises
i. Threading and tapping pipes
j. Reaming
k. Tubing and plastic pipe cutters
l. Flaring tools
m. Pipe tool care
    1. Cleaning and storage
    2. Lubricating
    3. Maintaining

Provide Demonstration On:

The proper way to hold and use a pipe wrench

Provide Practical Application On:

Tighten a pipe fitting with a pipe wrench.

INSTRUCTIONAL MATERIALS

Textbooks:

Dover Publications, Tools and Their Uses

A/Vs:

Hobar, "Laboratory Exercise in Pipefitting"

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Three

Tools and Equipment:

a. Several types of pipe wrenches
b. Pipes and fittings

CLASSROOM HOURS 6

EVALUATION (T-03)

Given a pipe fitting, the student will select the appropriate pipe wrench from the tool room and tighten the fitting using the proper technique. The completed task must comply with the instructor's specifications.

TASK

T-04 Identifying and using plumbing tools

PERFORMANCE OBJECTIVE

Identify and use plumbing tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three basic areas of plumbing
   1. Water supply
   2. Drainage
   3. Fixtures
b. Plumbing codes
c. The plumbing system
d. The water supply system
e. Tube bending
   1. Tools
   2. Procedure
f. Cutting cast iron sail pipe
g. Using sail pipe assembly tool
h. Force-up plungers
i. Closet augers
j. Line clearing tools
k. Seven tapes
l. Internal wrench
m. Basin wrenches
n. End-hex wrenches
o. Measuring pipe

Provide Demonstration On:

a. Bending tube
b. Measuring pipe

Provide Practical Application On:

a. Use a tube bender to bend tube.
b. Measure a length of pipe.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dover Publications, Tools and Their Uses
b. Audel, Plumbers and Pipefitter's Library

Student Manuals:

a. Plant Engineering Training Systems, Hand Tools, Lesson Four
b. Mid America, Residential Plumbing

CLASSROOM HOURS 6

EVALUATION (T-04)

a. Given a selection of plumbing tools, the student will identify and describe each tool and its function with 100% accuracy.

b. Given a length of tube and a tube bender, the student will bend the tube according to specifications designated by the instructor.

c. Given a length of pipe and specifications, the student will correctly measure and cut it according to the instructor's specifications.

TASK

T-05 Identifying and using electrical tools

PERFORMANCE OBJECTIVE

Identify and use electrical tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. EMT Bender
    1. NEC standards for bends
    2. Usind the bender
b. Correcting knocked over stubs
c. Bending rigid conduit
d. Hydraulic benders
e. Assembling rigid conduit
f. Fish tapes
    1. Basket cable grip
    2. Wire and cable grip
g. Knock-out punches
h. Pliers
i. Wire and cable strippers
j. Special screwdrivers
    1. Tightening wire connection screwdriver
    2. Off-set screwdriver
    3. Screw holding screwdriver
k. Voltage tester
l. Fuse pullers

Provide Demonstration On:

Bending conduit

Provide Practical Application On:

a. Bend a conduit
    1. Flexible
    2. Rigid
b. Use a knock-out punch to punch a hole in box for conduit.

INSTRUCTIONAL MATERIALS

Textbooks:

AAVIM, Electrical Wiring

A/Vs:

Hobar, "Housewiring"

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Five

Tools and Equipment:

a. EMT bender
b. Selection of electrical tools

CLASSROOM HOURS 6

EVALUATION (T-05)

Given a selection of tools used in electrical work, the student will identify, describe and utilize each tool necessary for bending a conduit. The bend must comply with the instructor's specifications.

TASK

T-06 Identifying and using cement, plaster and glazing tools

PERFORMANCE OBJECTIVE

Identify and use cement, plaster and glazing tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mortars and concrete
b. Brick masonry tools
c. Line and pins
d. Brick and block repairing tools
    1. Tuck pointing
    2. Hammer and chisel
e. Cement masonry tools
f. Jointing, edging and finishing
g. Plastering tools
h. Using plaster application hand tools
i. Repairing plaster
j. Repairing wallboard
k. Glazing tools
l. Replacing broken panes

Provide Demonstration On:

Applying plaster

Provide Practical Application On:

Using the correct tools, apply plaster to a wall.

INSTRUCTIONAL MATERIALS

Textbooks:

a. White, Concrete Technology
b. Moore, Concrete Form Construction
c. Smith, Principles and Practices of Heavy Construction
d. Nautra, Builder I & C 10649F
e. Prentice-Hall Media, Masonry and Concrete

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Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Six

Tools and Supplies:

a. Mortar board
b. Flat trowel
c. Selection of masonry tools

CLASSROOM HOURS

6

EVALUATION (T-06)

Given a selection of masonry tools, the student will identify the tool and demonstrate the proper use by applying plaster to a given location.

INSTRUCTIONAL MATERIALS

Textbooks:

f. Hobar Publications, MTR-II
g. Hobar Publications, MTR-IV
h. Hobar Publications, MTR-V
i. Hobar Publications, MTR-III

TASK

T-07 Identifying and using wood working tools

PERFORMANCE OBJECTIVE

Identify and be able to use wood working tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Handsaws
b. How to use a cross-cut saw
c. How to use a rip saw
d. Special purpose saws
e. Planes
f. Using the plane
g. Boring and drilling holes
h. Hand drills
i. Woodworking chisels
j. Levels
k. Plumb bobs
l. Nail hammers and nail sets
m. Marking gazes-beam and head
n. Wood scrapers
o. Tool maintenance and care

Provide Practical Application On:

Identify tools in the tool room

INSTRUCTIONAL MATERIALS

Textbooks:

a. Reed, Residential Carpentry
b. NAUTRA, Builder I & C
c. Dover Publication, Tools and Their Uses

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Seven

A/Vs:

a. Prentice-Hall, XF-1121
b. Prentice-Hall, XF-1120
c. Hobar, "Hammers, Nails and Nailing Techniques"
d. Hobar, "Transparencies" WHT-1
e. Bergwall, "Woodworking Handtools Explained"

CLASSROOM HOURS 6

EVALUATION (T-07)

Given an assortment of woodworking tools, the student will identify the tool and demonstrate its appropriate use. The task must be in accordance with the instructor's requirements. The following tools will be identified:

1. Handsaws
2. Planes
3. Drills
4. Chisels
5. Levels
6. Hammers

TASK

T-08 Identifying and using sheet metal tools

PERFORMANCE OBJECTIVE

Identify and use sheet metal tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of sheet metal
b. Sheet metal gazes
c. Sheet metal layout
d. Dividers
e. Punches
f. Rivet set
g. Metal cutting chisels
h. Hammer
i. Metal cutting snips
j. Aviation pattern snips
k. Dressing a cut metal sheet
l. Sheet metal notchers
m. Sheet metal punching tools
n. Bench stakes
o. Sheet metal forming tools
p. Hand screamers
q. Soldering
r. Sheet metal safety

Provide Practical Application On:

Identify metal working tools in the tool room and describe/ demonstrate the use of the tools.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Ludwig and McCarthy, *Metal Work Technology and Practice*
b. Walker, *Modern Metal-Working*

A/Vs:

a. Hobar, "Sheet Metal Hand Tools"
b. Bergwall, "Sheet Metal Work"

Student Manuals:

a. Plant Engineering Training Systems, *Hand Tools, Lesson Eight*
b. California State Department of Education, *Sheet Metal Tools and Equipment Workbook*

Tools and Equipment:

Collection of metal working tools

CLASSROOM HOURS 6

EVALUATION (T-08)

Given a selection of metal working tools, the student will identify the tool and demonstrate its proper use. The following tools will be identified:

1. Sheet metal gazes
2. Punches
3. Chisels
4. Rivet sets
5. Hammers
6. Tin snips
7. Forming tools
8. Soldering tools

TASK

T-09 Identifying and using metalworking tools

PERFORMANCE OBJECTIVE

Identify and be able to use metalworking tools ovserving correct procedure.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Machine's vise
b. Hacksaws
c. Files
d. File cuts
    1. Single
    2. Double
e. File designations
f. File shape
    1. Tapered
    2. Blunt
g. Selecting a file
h. Taps
i. Tap sets
j. Tap sizes
k. Tap wrenches
l. Uses of taps
m. Tapping lubricants
n. Dies
o. Obtaining desired fit
p. Using dies
q. Plates
r. Reamers

Provide Demonstration On:

a. Using a hacksaw properly
b. Proper use of a file

Provide Practical Application On:

a. Use a hacksaw to cut metal properly.
b. Use a file on metal observing appropriate procedure.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Ludwig and McCarthy, Metal Work and Technology and Practice
b. Walker, Modern Metal Working

Student Manuals:

Plant Engineering Training Systems, Hand Tools, Lesson Nine

Tools and Equipment:

a. Hacksaw
b. File
c. Metal material
d. Other examples of metal working tools

CLASSROOM HOURS 6

EVALUATION (T-09)

Given a selection of metal working tools, the student will correctly identify the tools and use the hacksaw and file in the appropriate manner.

TASK

T-10 Identifying and using hoisting and pulling tools

PERFORMANCE OBJECTIVE

Identify and use hoisting and pulling tools and use a block and tackle to hoist an object.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Block and tackle
    1. Mechanical advantage
    2. Safety
b. Angle of lift
c. Slings
d. Using hitches
    1. Straight
    2. Choker
    3. Basket
    4. Bridle
e. Spreader beams
f. Sling inspection
g. Forged link charms
h. Fabric slings
i. Wire rope slings
j. Chain falls
k. Ropes
    1. Manila rope
    2. Stretching
l. Wire rope and cable
m. Knots and knot terminology
    1. Standing part, bight, end
    2. Reef knot
    3. Square knot
    4. Figure eight knot
    5. Fisherman's knot
    6. Bowline knot
    7. Timber hitch
    8. Clovi hitch
    9. Cats paw

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INSTRUCTIONAL MATERIALS

Textbooks:

Morrow, Maintenance Engineering Handbook

Student Manuals:

a. Plant Engineering Training Systems, Hand Tools, Lesson Ten
b. Oregon BOE, Unit 301-C

Tools and Equipment:

Block and tackle

CLASSROOM HOURS 6

EVALUATION (T-10)

Given an assortment of hoisting and pulling tools, the student will identify and describe the proper use of each and demonstrate the proper use of a block and tackle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    10. Round turn and two half-hitches
    11. Sheep shank
    12. Whipped ends
n. Machine part pullers
o. Vow pullers
p. Push-pullers
q. Slide hammer pullers
r. Choosing the right puller

Provide Practical Application On:

Using a block and tackle

TASK

SP-01 Identifying plant safety procedures

PERFORMANCE OBJECTIVE

Identify general plant safety procedures and locate and correct safety hazards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Who is responsible for safety
b. Accidents and injuries
c. The accident chain
d. Built-in hazards
e. Human influences on safety

Provide Practical Application On:

Identify dangerous conditions in the shop.

INSTRUCTIONAL MATERIALS

Textbooks:

AAVIM, Developing Shop Safety Skills

A/Vs:

a. AAVIM, "Developing Shop Safety"
b. Career Aids, Inc., "Safe-titudes"
c. Career Aids, Inc., "General Shop Safety"

Student Manuals:

a. Plant Engineering Training Systems, Plant Safety, Lesson One
b. AAVIM, Developing Shop Safety Skills

CLASSROOM HOURS 2

EVALUATION (SP-01)

Given a safety hazard in the shop, the student will locate the safety hazard and correct the situation according to the instructor's specifications.

TASK

SP-02 Observing safety precautions for tools and equipment

PERFORMANCE OBJECTIVE

Observe all safety precautions when using tools and equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hand tools
   1. Defective tools
   2. Using wrong tool
   3. Right tool, wrong method
   4. Improper tool maintenance
b. Built-in hazards
c. Powered hand tools
d. Pneumatic tools
e. Tool bit safety
f. Gasoline powered tools
g. Explosive powder tools
h. Portable ladders
i. Step ladders
j. Ladder safety
k. Fixed ladders
l. Ladder inspection
m. Scaffolds and working platforms

Provide Practical Application On:

Describe the safety precautions for using tools in the shop/plant.

INSTRUCTIONAL MATERIALS

A/Vs:

a. Hobar, slide sets SMP-II, SMP-III and SMP-IV
b. Hobar, "Power Tool Safety and Operation"
c. Career Aids, Inc., "Using Hand Tools Part 1 and 2"
d. Career Aids, Inc., "Using Power Tools"

Student Manuals:

a. Plant Engineering Training Systems, Plant Safety, Lesson Four
b. Hobar, Power Tool Safety and Operation

Tools and Equipment:

Selection of shop tools

CLASSROOM HOURS 2

EVALUATION (SP-02)

Given a selection of shop tools, the student will describe procedures for the safe use of the tools.

TASK

SP-03 Identifying machinery safeguards

PERFORMANCE OBJECTIVE

Identify safeguards when operating machinery.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Machine guards
b. Hazardous motions
    1. High speed rotating parts which appear to stand still
    2. Inrunning nip points
c. Locking out power
d. Locking moving parts
e. Point of operation machinery guarding
f. Barrier and enclosure guards
g. Controls and Operating safety
h. Mechanical power transmission guards

Provide Practical Application On:

Describe safety procedures for power tools in the shop.

INSTRUCTIONAL MATERIALS

A/Vs:

Hobar, "Power Tool Safety and Operation"

Student Manuals:

a. Plant Engineering Training Systems, Plant Safety, Lesson Five
b. Hobar, Power Tool Safety and Operation

Tools and Equipment:

Selection of power tools

CLASSROOM HOURS

2

EVALUATION (SP-03)

Given a series of power tools in the shop, the student will identify and describe the safety precautions for each machine according to the instructor's specifications.

TASK

SP-04 Observing safety in handling materials

PERFORMANCE OBJECTIVE

Observe all safety precautions when handling materials using lift-and-carry procedures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Material handling injuries
    1. Causes
    2. Avoiding injuries
b. Manual lifting, carrying, setting
c. Built-in material hazards
d. Team handling
e. Handling special shapes and sizes
f. Hand tools and accessories
g. Hand trucks, dollies, wheelbarrows
h. Powered industrial trucks
i. Conveyors, chutes, troughs
j. Hoists and cranes
k. Receiving and storage
l. Storage safety
m. Chemicals and flammable materials
n. Materials handling and lighting

Provide Practical Application On:

Lift an object (crate or similar), carry and set it in place. Follow all safety rules.

INSTRUCTIONAL MATERIALS

A/Vs:

Career Aids, Inc., "Lift With Your Head"

Student Manuals:

Plant Engineering Training Systems, Plant Safety, Lesson Three

Tools and Equipment:

Crates or other objects to lift

CLASSROOM HOURS

2

EVALUATION (SP-04)

Given an object, the student will lift, carry and set the object in a designated location. The procedure must be in accordance with the instructor's specifications.

TASK

SP-05 Identifying work area safety precautions

PERFORMANCE OBJECTIVE

Identifying safety precautions for the work area and be able to correct the situation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hazards
    1. Mechanical
    2. Electrical
    3. Chemical
    4. Environmental
b. Build-in hazards
c. Moving machinery
d. Plant traffic
e. Safety at heights
f. Safety in extreme heat
g. Enclosed areas
h. Flammability and toxicity problems
i. Chemical safety
j. Utility maintenance safety
k. Radiation

Provide Practical Application On:

Identify safety hazards in the work area.

INSTRUCTIONAL MATERIALS

A/Vs:

Career Aids, Inc., "Safety at Work"

Student Manuals:

Plant Engineering Training Systems, Plant Safety, Lesson Two

CLASSROOM HOURS 2

EVALUATION (SP-05)

Given a safety hazard in the work area, the student will identify the hazard and correct the situation according to the instructor's specifications.

TASK

SP-06 Identifying fire prevention procedures

PERFORMANCE OBJECTIVE

Identify procedures for fire prevention.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How fires start
  1. Fuel, heat, oxygen
  2. Spontaneous combustion
  3. External ignition
  4. Flash point

b. Volatile liquids, materials
  1. Gasoline
  2. Fuel oils
  3. Carbon monoxide
  4. Dusts, powders

c. Ordinary combustibles

d. Fire prevention

e. Four classes of fire
  1. Class A-ordinary combustibles-extinguishers
  2. Class B-flammable liquids-extinguishers
  3. Class C-electrical equipment-extinguishers
  4. Class D-combustible metals-extinguishers

Provide Practical Application On:

Given a fire type/class, the student will choose the correct extinguisher.

INSTRUCTIONAL MATERIALS

Textbooks:

Colburn, Fire Protection and Suppression

A/Vs:

Career Aids, Inc., "School Shop Safety"

Student Manuals:

Plant Engineering Traing Systems, Plant Safety, Lesson Nine

Tools and Equipment:

Four types of fire extinguishers

CLASSROOM HOURS

2

EVALUATION (SP-06)

Given a description of a fire, the student will correctly choose the type of fire extinguisher which will safely extinguish the fire. The student will also accurately identify fire prevention procedures.

TASK

SP-07 Handling hazardous materials

PERFORMANCE OBJECTIVE

Observe safety precautions when handling hazardous materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Materials hazards and injuries
   1. Inhaling
   2. Ingestion
   3. Absorption
b. Hazardous liquids
c. Using solvents
   1. Flash point
   2. Ventilation
d. Packaged materials
e. Normal exposure cautions
f. Sudden, unexpected exposure
g. Noise hazards
h. Welding hazards
i. Welding safery

Provide Demonstration On:

Handling solvents

INSTRUCTIONAL MATERIALS

Textbooks:

Anton, Occupational Safety and Health Management

A/Vs:

Career Aids, Inc., "Safety at Work"

Student Manuals:

Plant Engineering Training Systems, Plant Safety, Lesson Eight

Tools and Equipment:

a. Solvents
b. Fuel cans
c. Other hazardous materials

CLASSROOM HOURS

2

EVALUATION (SP-07)

Given a selection of hazardous materials in the shop, the student will identify the materials and describe the necessary related safety precautions according to the instructor's specifications.

TASK

SP-08 Observing electrical safety precautions

PERFORMANCE OBJECTIVE

Observe all precautions for electrical safety.

INSTRUCTIONAL ACTIVITIES

Provide Information on:

- a. Basic electricity
  - 1. Amperes
  - 2. Volts
  - 3. Ohms
  - 4. Ohm's Law
  - 5. Short circuit
- b. Electrical injuries
- c. Preventing electrical accidents
- d. Overcurrent protection
  - 1. Fuses
  - 2. Circuit breakers
- e. Grounding
  - 1. Ground faults
  - 2. GFC
- f. Hazardous location
- g. Double insulated tools
- h. General electrical safety rules

Provide Demonstration On:

Procedure for treating shock

INSTRUCTIONAL MATERIALS

A/Vs:

- a. Career Aids, Inc., "Electrical Safety in the Shop"
- b. Career Aids, Inc., "Electricity/Electronics"

Student Manuals:

Plant Engineering Training Systems, Plant Safety, Lesson Seven

CLASSROOM HOURS 2

EVALUATION (SP-08)

Given electrical safety rules for the shop, the student will identify and describe electrical safety procedures and devices according to the instructor's specifications.

TASK

SP-09 Identify personal protection gear

PERFORMANCE OBJECTIVE

Identify gear for personal protection.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Head protection
b. Eye protection
c. Face shields
d. Face and body shields
e. Ear protection
f. Foot protection
g. Respiratory protection
h. Processing air for respiration
i. Safety harnesses and lifelines
j. Gloves and special work clothes

Provide Demonstration On:

How to use a gas mask

Provide Practical Application On:

Select proper safety devices for assigned jobs.

INSTRUCTIONAL MATERIALS

Textbooks:

University of Missouri, Safety in Trade and Industrial Education Handbook

A/Vs:

University of Missouri, "Safety in Trade and Industrial Education"

Student Manuals:

Plant Engineering Training Systems, Plant Safety, Lesson Six

Tools and Equipment:

a. Selection of safety equipment

(Continued on back)

CLASSROOM HOURS

2

EVALUATION (SP-09)

Given an assigned job in the shop, the student will choose the appropriate personal safety devices for the job according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Tools and Equipment:

1. Hard hats
2. Steel toes
3. Face shields
4. Goggles
5. Safety glasses
6. Gas mask

TASK

EM-01 Identifying the nature of force

PERFORMANCE OBJECTIVE

Identify the nature of force.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Force
   1. Force and stationary objects
   2. Force and work
b. Standards of measurement
   1. English system
   2. Metric system
c. Direction of force
   1. Horizontal
   2. Vertical
   3. Slanted
   4. Angle to one another
   5. Vertex
d. Gravity
e. Weight versus mass
f. Equilibrium
   1. Static forces
   2. Static balance
   3. Neutral equilibrium
   4. Stable
   5. Unstable
g. Action forces
   1. External
   2. Internal
   3. Concurrent
   4. Parallel
   5. Opposite
   6. Tension
   7. Compression
   8. Torque
   9. Shear
h. Application of forces in the plant

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson One

CLASSROOM HOURS

3

EVALUATION (EM-01)

Given pictures or live examples of various activities in a plant, the student will accurately identify the type of working force used.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Identify types of working forces from pictures or in a plant.

TASK

EM-02 Identifying physical properties of motion

PERFORMANCE OBJECTIVE

Identify physical properties of motion.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Motion
- b. Gravity
  - 1. Sir Isaac Newton
  - 2. Galileo
  - 3. Distance = acceleration x $(\text{time})^2$
- c. Velocity
- d. Acceleration
- e. Principles of motion
  - 1. Linear
  - 2. Rotary
  - 3. Absolute
  - 4. Relative
  - 5. Harmonic
- f. Newton's Laws of Motion
  - 1. First Law of Motion
  - 2. Inertia
  - 3. Second Law of Motion
  - 4. Third Law of Motion
- g. Linear Motion
- h. Circular motion
  - 1. Curved motion
  - 2. Centripetal and centrifugal forces
- i. Rotary motion
- j. Relative motion
- k. Harmonic motion
  - 1. Equilibrium
  - 2. Amplitude
  - 3. Frequency

Provide Demonstration On:

Working motion problems

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Two

CLASSROOM HOURS 3

EVALUATION (EM-02)

Given an overview of the principles of motion, the student will correctly identify the basic principles of motion and work specific problems related to properties of motion.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Work problems on velocity, acceleration and deceleration.

TASK

EM-03 Identifying principles of work and energy

PERFORMANCE OBJECTIVE

Identify principles of work and energy.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Work
    1. Types of work
    2. Vertical and horizontal force
b. Power
    1. Amount of work per time
    2. Foot-pounds per second
    3. Horse power
c. Energy
    1. Kinetic
    2. Potential
d. Kinetic energy
    1. Definition
    2. Kinetic energy = $\frac{1}{2}\frac{MV^2}{32\ ft/sec^2}$
    3. Calculating kinetic energy
e. Potential energy
f. Transformation of energy
g. Collision and conservation of momentum
h. Types of collision
    1. Imperfectly elastic
    2. Perfectly elastic
    3. Perfectly inelastic

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Three

CLASSROOM HOURS 3

EVALUATION (EM-03)

Given an overview of the principles of work as related to energy, the student will define the principles of work and relate these to basic principles of energy. The completed task must comply with the instructor's specifications.

TASK

EM-04 Identifying principles of simple machines

PERFORMANCE OBJECTIVE

Identify basic principles of simple machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Simple machines
    1. Lever
    2. Wheel and axle
    3. Pulley
    4. Inclined plane
    5. Screw
b. Principle of work
c. The lever
    1. Fulcrum
    2. First, second and third class
    3. Calculating lever mechanical advantage
d. The inclined plane
    1. Uses
    2. Mechanical advantage
    3. Grade
e. The screw
f. The wedge
    1. Description
    2. The cam
g. Wheel and axle
h. Pulleys
    1. Fixed
    2. Movable
    3. Block and tackle
i. Jacking screws

Provide Practical Application On:

Identify practical applications of simple machines.

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Four

CLASSROOM HOURS 2

EVALUATION (EM-04)

Given basic principles of simple machines, the student will accurately identify applications of simple machines in the lab.

TASK

EM-05 Identifying practical applications of power

PERFORMANCE OBJECTIVE

Identify practical applications of power.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of power
   1. Electrical
   2. Pneumatic
   3. Hydraulic
   4. Steam
   5. Internal combustion engines
b. Methods of producing power
   1. Steam turbine
   2. Internal combustion engine
   3. Hydraulic and pneumatic motors
c. Mechanical efficiency
   1. Percentage efficiency
   2. Matching power to the job
d. Compound machines and gearing
   1. Simple gears
   2. Norm gear reducer
e. Selecting a crane reducer
f. Finding gear ratios and work forces
g. Determining work done by a crane hook
h. Word and speed of a forklift truck speed
i. Work done tightening a bolt

INSTRUCTIONAL MATERIALS

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Five

CLASSROOM HOURS 2

EVALUATION (EM-05)

Given a type of power and a method of producing that power, the student will accurately identify practical applications of that power. Answers will be graded according to the instructor's requirements.

TASK

EM-06 Calculating area and volume

PERFORMANCE OBJECTIVE

Calculate area and volume.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Units of measurement
  - 1. Pound
  - 2. Foot
  - 3. Second
  - 4. Degree
  - 5. Volt
- b. Measurements
  - 1. Linear measurements
  - 2. Weight
  - 3. Liquid measure
  - 4. Dry measure
  - 5. Time
- c. Area
  - 1. Square measure
  - 2. Triangle
  - 3. Trapezoid
  - 4. Circle
  - 5. Hollow rectangle
  - 6. Hollow circle
  - 7. Cylinder
- d. Finding an area within another area
- e. Volume
  - 1. Divide into geometric shapes and add areas
  - 2. Displacement method (for irregular shapes)
  - 3. Capacity method (irregular tank or cylinder)

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals on Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Six

CLASSROOM HOURS

2

EVALUATION (EM-06)

Given an object, the student will measure its dimensions and correctly calculate the volume of the object by the most accurate method. Work must comply with the instructor's specified requirements.

TASK

EM-07 Identifying and using hand tools

PERFORMANCE OBJECTIVE

Identify and use hand tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Screwdrivers
   1. Flat blade
   2. Phillips
   3. Socket head
   5. Offset

b. Parts of a screwdriver
   1. Blade
   2. Handle
   3. Shank

c. Safety
   1. Match blade to screw head
   2. Keep blade ends ground flat and square
   3. Handles free of oil, grease
   4. Do not use as punch or chisel.
   5. Do not use pliers or wrench to get more leverage.
   6. Always use the screwdriver with the blade from the body.

d. Hammers
   1. Carpenter's hammer (claw)
   2. Machinists's hammer (ball peen)·
   3. Soft face hammers

e. Hammer safety
   1. Keep the hammer free of oil or grease.
   2. Never leave a hammer on a ladder.

f. Wrenches
   1. Adjustable end wrench
   2. Pipe wrench

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Dover Publications, Inc., Tools and Their Uses

A/Vs:

a. Hobar, "Hammer, Nails and Nailing Techniques" and "Screws and Driving Tools"

b. DCA, "Hand Tools, Series One"

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics

Tools and Equipment:

a. Screwdrivers

b. Hammers

c. Chisels

d. Hacksaws

e. Wrenches

(Continued on back)

CLASSROOM HOURS

3

EVALUATION (EM-07)

Given a job, the student will identify the correct tools for the job and use the tools in the appropriate manner. The completed job must be in compliance with industry requirements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    3. Open end wrench
    4. Box end wrench
    5. Combination wrenches
    6. Socket wrenches, ratchet handle and speed handle
    7. Torque wrench
    8. Safety
g. Pliers
    1. Slip-joint pliers
    2. Water-pump pliers
    3. Grooved or arc joint pliers
    4. Locking pliers
    5. Safety
h. Hacksaws
i. Punches and chisels
    1. Center punch
    2. Aligning punch
    3. Drift punch
    4. Gasket punch
j. Drills
k. Files
l. Tin snips
m. Taps and dies
    1. Taper
    2. Plug
    3. Bottoming
    4. T-handle
    5. Straight handle

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Pliers
g. Drills
h. Taps and dies

TASK

EM-08 Identifying and using power tools

PERFORMANCE OBJECTIVE

Identify and use power tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safe use of portable power tools
    1. Personal safety
    2. Electrical safety
b. Drills
    1. Chuck
    2. Drill safety
c. Sanders
    1. Disc
    2. Belt
    3. Reciprocating orbital
d. Portable grinders
e. Portable circular saw
f. Saber saw
g. Metal shears
h. Electric impact wrench
i. Rotary hammer
j. Portable pneumatic impact wrench
k. Pneumatic chipping hammer
l. Common power machine tools
    1. Drill press
    2. Bench grinder

INSTRUCTIONAL MATERIALS

Textbooks:

Dover Publications, Inc., Tools and Their Uses

A/Vs:

Hobar, "Using Portable Power Tools", "Drill Press Parts and Controls" and "Tool Grinder"

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Eight

Tools and Equipment:

a. Drills
b. Sanders
c. Grinders
d. Circular saw
e. Drill press
f. Bench grinder

CLASSROOM HOURS

3

EVALUATION (EM-08)

Given a selection of power tools, the student will accurately identify each tool, describe its use and identify safety rules for operation of the tool. The following tools will be used:

1. Drills
2. Sanders
3. Grinders
4. Circular saw
5. Drill press
6. Bench grinder

TASK

EM-09 Identifying types of fasteners

PERFORMANCE OBJECTIVE

Identify types of fasteners and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Bolt failure
- b. Screw threads
  - 1. Helix
  - 2. External or internal
  - 3. Root
  - 4. Crest
  - 5. Pitch
  - 6. Lead
  - 7. Thread angle
  - 8. Reason for different types of threads
- c. Screw thread specifications
  - 1. Thread diameter
  - 2. Threads per inch
  - 3. Thread type
  - 4. External threads-1A, 2A, 3A
  - 5. Internal threads-1B, 2B, 3B
- d. Reading thread specifications
- e. Threaded fasteners
  - 1. Bolt
  - 2. Stud
  - 3. Cap screw
  - 4. Machine screw
  - 5. Set screw
- f. Nuts
- g. Washers
  - 1. Flat
  - 2. Conical
  - 3. Helical spring
  - 4. Spring washers
  - 5. Tooth lock washers
- h. Rivets
- i. Pin fasteners

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Dover, Tools and Their Uses

Student Manuals:

Plant Engineering Training System, Elements of Mechanics, Lesson Nine

Tools and Equipment:

Several types of fasteners

CLASSROOM HOURS 1

EVALUATION (EM-09)

Given a selection of fasteners, the student will accurately identify the type of fastener and describe its application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Keys
    1. Keystock
    2. Gib-head
k. Special purpose fasteners
    1. Self tapping screws
    2. Locking nut fasteners
    3. Self-retaining nuts
    4. Plate or anchor nuts
    5. Caged nuts
    6. Clinch nuts
    7. Self-piercing nuts
l. Corrosion
    1. Direct attack
    2. Galvanic corrosion
    3. Concentration cell
    4. Fretting
    5. Oxidation
    6. Stress corrosion cracking
    7. Corrosion fatigue

TASK

EM-10 Identifying properties of friction

PERFORMANCE OBJECTIVE

Identify properties of friction.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Problems caused by friction
b. Laws and conditions of friction
c. Classes of friction
   1. Static
   2. Kinetic
d. Application of friction
e. Angle of repose

Provide Practical Application On:

a. Calculate angle of repose.
b. Calculate angle of friction.

INSTRUCTIONAL MATERIALS

Textbooks:

Olivio and Olivio, Fundamentals of Applied Physics

Student Manuals:

Plant Engineering Training Systems, Elements of Mechanics, Lesson Ten

CLASSROOM HOURS

2

EVALUATION (EM-10)

Given specifications for an object to be stored in bulk, the student will make all calculations relative to safe storage including angle of repose and angle of friction. The calculation must comply with the instructor's requirements.

TASK

L-01 Identifying basic principles of lubrication

PERFORMANCE OBJECTIVE

Identify basic principles of lubrication.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lubrication
b. Basic purposes of lubricants
    1. Reduce friction
    2. Reduce wear
    3. Dampen shock
    4. Cool moving elements
    5. Prevent corrosion
    6. Seal out contaminants
c. Classifications of lubricants
    1. Liquid
    2. Semi-solid
    3. Solid
    4. Gas
d. Sliding and rolling friction
e. Types of motion
    1. Rotary
    2. Linear
    3. Combination
f. Wear
g. Dampening shock
h. Cooling action of lubricants
i. Corrosion prevention
j. Lubricants as seals
k. Other actions of lubricants
    1. Flushing action
    2. Power transmission

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson One

A/Vs:

DCA, "Lubricants"

CLASSROOM HOURS 6

EVALUATION (L-01)

Given an overview of lubricants and their applications, the student will accurately identify basic principles of lubricants and identify their applications.

TASK

L-02 Identifying characteristics of lubricants

PERFORMANCE OBJECTIVE

Identify characteristics of lubricants.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. History of lubrication
b. General action of lubricants
  1. Prevent corrosion
  2. Protective, slippery film
c. Types of lubricants
d. Refining of lubricants
  1. Petroleum
  2. Wells
e. Manufacture of lubricants
  1. Distillation
  2. Solvent refining
  3. Filtering through special clay
f. Chemistry of lubricants
  1. Elements
  2. Molecules
  3. Hydrocarbons
g. Properties of lubricants
  1. Viscosity
  2. Viscosity index
  3. Flash point
  4. Fire point
  5. Pour point
  6. Oxidation resistance
  7. Emulsification and demulsification
h. Viscosity
  1. Fluid thickness
  2. SAE
  3. SSV, SVS
  4. Viscometer

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INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Two

Tools and Equipment:

a. Laboratory type still
b. Oils
c. Greases

CLASSROOM HOURS 3

EVALUATION (L-02)

Given a machine which needs lubrication, the student will accurately select the appropriate oil and/or grease. The selection must be approved by the instructor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Greases
    1. Soap
    2. Hardness
    3. Dropping point
j. Lubricant selection
    1. Load
    2. Speed
    3. Pressure
    4. Environment
    5. Pumpability
    6. Water resistance
    7. Stability

Provide Demonstration On:

Use a laboratory type still to demonstrate refining principles.

Provide Practical Application On:

Choose the appropriate oil and/or grease for a given machine.

TASK

L-03 Identifying additives, lubricating action and bearing lubrication

PERFORMANCE OBJECTIVE

Identify additives, lubricating action and bearing lubrication.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Additives
    1. Purpose
    2. Types
b. Multi-purpose lubricants
c. Types of lubricants
    1. Dry friction
    2. Mixed film
    3. Boundary lubrication
    4. Full film
d. Bearings
    1. Plain bearings
    2. Anti-friction bearings
e. Plain bearing types
    1. Journal bearings
    2. Thrust bearings
    3. Guide or slipper bearings
f. Journal bearings
    1. Solid bearings
    2. Split bearings
    3. Half bearing
    4. Multi-part bearings
g. Anti-friction bearings
h. Bearing lubrication

Provide Practical Application On:

Grease bearings on a machine.

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Three

Tools and Equipment:

a. Oil
b. Grease
c. Funnel
d. Grease gun

CLASSROOM HOURS

6

EVALUATION (L-03)

Given a machine with dry bearings, the student will identify the type of bearings and choose the appropriate method for lubricating them.

TASK

L-04 Identifying oils and their applications

PERFORMANCE OBJECTIVE

Identify oils and describe their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Oils
  - 1. Load, temperature, speed and environment
  - 2. Animal oils
  - 3. Mineral oils
  - 4. General or special purpose
  - 5. Additives
- b. Oil bases
  - 1. Paraffin-base
  - 2. Napthenic-base
  - 3. Asphaltic-base
  - 4. Mixed base
- c. Equipment
- d. Types of oil lubricants
  - 1. Circulating oils
  - 2. Gear oils
  - 3. Machine engine oils
  - 4. Spindle oils
  - 5. Refrigeration oils
  - 6. Steam-cylinder oils
- e. Steel-mill circulating oils
- f. Heavy-duty internal combustion engine oils
- g. Gear oils
- h. Machine and engine oils
  - 1. Light way oil
  - 2. Medium way oil
  - 3. Heavy way oil
- i. Spindle oils
- j. Refrigeration oils
- k. Steam cylinder oils
- l. Additional oil applications
  - 1. Electric motors
  - 2. Chains
  - 3. Special purpose oils

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Four

CLASSROOM HOURS 6

EVALUATION (L-04)

Given specifications for a machine, the student will accurately identify the type of oil used and its application.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Identify the type of oil for a particular type of machine.

TASK

L-05 Identifying general purpose greases

PERFORMANCE OBJECTIVE

Identify general purpose greases and describe their application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Defining greases
    - 1. Hardness
    - 2. Dropping point
    - 3. Pumpability
    - 4. Water resistance
    - 5. Stability
- b. Elements of grease
    - 1. Oil
    - 2. Thickening agent
    - 3. Additives
- c. Characteristics of grease
    - 1. Base
    - 2. Dropping point
    - 3. Penetration
- d. Additional characteristics of grease
    - 1. Texture
    - 2. Temperature
- e. Lubricating action of grease
- f. Reasons for using grease
    - 1. Applications where lubricant can't drip
    - 2. Inaccessibility of parts
    - 3. High operating temperatures
    - 4. Sealing out contaminants
- g. How greases are made
    - 1. Cold made grease
    - 2. Heating or "cooking"
- h. Types of greases
    - 1. Mixtures of mineral oils and solid materials
    - 2. Heavy, asphaltic type oils
    - 3. Extreme pressure greases
    - 4. Roll-neck greases
    - 5. Soap-thickened mineral oils

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Five

Tools and Equipment:

Several types of grease

CLASSROOM HOURS

6

EVALUATION (L-05)

Given several types of greases, the student will correctly identify the type of grease and describe its applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Common soaps
   1. Calcium
   2. Sodium
   3. Barium
   4. Lithium
   5. Strontium
   6. Lead
j. Applications
   1. Plain bearing greases
   2. Anti-friction bearings and grease
   3. Bearing re-lubrication

Provide Practical Application On:

Identify several types of greases and describe their applications.

TASK

L-06 Identifying special purpose greases

PERFORMANCE OBJECTIVE

Identify special purpose greases and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Multipurpose greases
- b. Additives
  - 1. Protect against chemical change
  - 2. Improve or give new characteristics to a lubricant
  - 3. Protect the equipment from electrolytic effects
- c. Extreme pressure grease
- d. Water repellent grease
- e. Combined greases
- f. High and low temperature greases
  - 1. Graphite
  - 2. Molybdenum disulfide
- g. Silicone grease
  - 1. Also used in high temperature applications
  - 2. Permanently sealed bearings
- h. Dry film lubricants
  - 1. Choosing a dry film lubricant
  - 2. Application

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Six

CLASSROOM HOURS 6

EVALUATION (L-06)

Given an overview of special purpose greases, the student will identify special purpose greases and describe their applications.

TASK

L-07 Identifying lubricating compounds

PERFORMANCE OBJECTIVE

Identify and describe lubricating compounds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of compounds
b. Types of compounds
    1. Natural
    2. Synthetic
c. Liquid lubricants
    1. Petroleum oils
    2. Vegetable oils
    3. Fish oils
d. Petroleum base oils
    1. Paraffin-base
    2. Mapthenic-base
    3. Mixed base
e. Synthetic liquid lubricants
f. Monoester
    1. Monobasic acids
    2. Monohydric alcohols
g. Dibasic acid esters
h. Phosphate ester
i. Silicone polymers
j. Silicate esters
k. Solid lubricants
    1. Inorganic
    2. Organic
    3. Metal film lubricants
l. Laminar solids
    1. Graphite
    2. Tungsten disulfide
    3. Mica
    4. Boron nitride
    5. Borax
    6. Cadmium ioxide
m. Soft solids
n. Chemical coatings
    1. Sulfide

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Seven

Tools and Equipment:

a. Oils
b. Greases

CLASSROOM HOURS 2

EVALUATION (L-07)

Given an oil or a grease, the student will correctly identify and describe the structure of the compounds.

INSTRUCTIONAL ACTIVITIES

Provide Information On:	Provide Practical Application On:
2. Chloride 3. Oxide 4. Prosprate 5. Oxalate o. Organic compounds 1. Soaps 2. Fats 3. Waxes p. Polymers	Describe the compounds used in various types of oils and greases.

TASK

L-08 Identifying lubrication systems and methods

PERFORMANCE OBJECTIVE

Identify and describe lubrication systems and methods.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Purpose of a lubrication system
- b. Considerations of a lubricating device
  - 1. Lubricant delivery
  - 2. Reliability
  - 3. Overall design
  - 4. Cost
- c. Lubricating delivery
  - 1.. Regulation
  - 2. Adaptability
  - 3. Continuity
- d. Reliability
  - 1. Start and stop automatically
  - 2. Purge or clear itself
- e. Cost considerations
  - 1. Initial cost
  - 2. Maintenance
  - 3. Repair
- f. Overall design considerations
  - 1. Space
  - 2. Safety
  - 3. Leakage
  - 4. Number of machines on the system
- g. Categories of lubricating methods
  - 1. Manual
  - 2. Gravity
  - 3. Natural
  - 4. Pressure

(Continued on back)

INSTRUCTIONAL MATERIALS

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Eight

CLASSROOM HOURS 3

EVALUATION (L-08)

Given a machine with a lubricating system, the student will correctly identify the type of lubricating system and describe its operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Pressure lubrication
    1. Dry sump system
    2. Wet sump system
    3. Oil mist system

TASK

L-09 Identifying automatic lubrication methods

PERFORMANCE OBJECTIVE

Identify methods of automatic lubrication.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Automatic lubrication
  1. For oiling
  2. For greasing
b. Oil lubrication
c. Sight glass plow indicators
  1. Tapered
  2. Parallel
  3. Low pressure
  4. Safety
d. Spray valves
e. Metered systems
f. Single-line metering
g. Two-line metering
h. Progression metering

Provide Practical Application On:

On a diagram, identify the method of automatic lubrication.

INSTRUCTIONAL MATERIALS

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Nine

Tools and Equipment:

Diagrams of lubricating systems

CLASSROOM HOURS 2

EVALUATION (L-09)

Given a diagram of an automatic lubricating system, the student will correctly identify the type of system and describe its method of operation.

TASK

L-10 Identifying methods of lubricant storage and handling

PERFORMANCE OBJECTIVE

Identify methods of storing and handling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Importance of proper storage
- b. General type of storage
  - 1. Inside
  - 2. Outside
- c. In-plant handling
  - 1. Drum and tank dispensary
  - 2. Direct dispensing
- d. Inventory and rotating stock
- e. Purification and reclamation
- f. Gravity separation
  - 1. Gravity settling
  - 2. Centrifuges
  - 3. Strainers
  - 4. Absorbent filters
- g. Safety

Provide Practical Application On:

Describe the appropriate safe handling method for a given lubricant

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Standard Handbook of Lubrication Engineering

Student Manuals:

Plant Engineering Training Systems, Lubrication, Lesson Ten

Tools and Equipment:

Several types of containers of lubricants

CLASSROOM HOURS 6

EVALUATION ((L-10)

Given a lubricant, the student will correctly identify the appropriate method of storage. The student must adhere to all safety precautions for proper handling of the lubricant.

TASK

DS-01 Identifying common couplings

PERFORMANCE OBJECTIVE

Identify common couplings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Couplings
b. Coupling requirements
    1. Couple two rotating shafts
    2. Compensate for shaft misalignment
    3. Allow axial or end movement of the coupled shafts
    4. Dampen vibrations
    5. Dampen/absorb torque
    6. Electrical installation
c. Types of misalignment
    1. Parallel
    2. Angular
    3. Combined parallel and angular
d. Solid couplings
    1. Flanged type
    2. Ribbed
    3. Universal joint
    4. Installing a flanged coupling
e. Jaw couplings
    1. Metal-to-metal contact
    2. Flexible coupling
f. Molded rubber couplings
g. Chain type couplings
h. Gear type couplings
i. Metal disc couplings

Provide Practical Application On:

Identify types of couplings and describe their operation and application.

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Training Systems, Drive Components, Lesson One

Tools and Equipment:

Examples of several types of couplings

CLASSROOM HOURS 6

EVALUATION (DS-01)

Given examples of couplings, the student will correctly identify the coupling and describe its operation and application.

TASK

DS-02 Identifying special couplings

PERFORMANCE OBJECTIVE

Identify couplings for special applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coupling requirements
b. Shear pin couplings
c. Torque limiting couplings
d. Brake wheel couplings
e. Floating shaft couplings
f. Spaces couplings
g. Limited end float
h. Electrically insulated couplings
i. Torsionally soft couplings
j. Sheave mounted couplings
k. Continuously lubricated couplings
l. Coupling selection factors
m. Coupling maintenance

Provide Practical Application On:

Determine coupling requirements for a special application.

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Training Systems, Drive Components, Lesson Two

CLASSROOM HOURS

3

EVALUATION (DS-02)

Given specifications for an application requiring a special purpose coupling, the student will identify an appropriate coupling which meets the requirements of the job and the instructor's specifications.

TASK

DS-03 Identifying clutches

PERFORMANCE OBJECTIVE

Identify clutches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compare clutches and couplings
b. Classes of clutches
    1. Mechanical
    2. Electrical
    3. Hydraulic
c. Jaw clutches
    1. Slow speed applications
    2. Shifting arm
d. Friction clutches
e. Tooth type mechanical clutches
f. Friction type centrifugal clutches
g. Over-running or one way clutches
h. Electric clutches
i. Fluid clutches

Provide Practical Application On:

Determine the type of clutch needed for a given application.

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Training Systems, Clutches, Lesson Three

CLASSROOM HOURS 6

EVALUATION (DS-03)

Given specifications for an application which requires a clutch, the student will identify and describe a clutch. The completed task must meet the instructor's requirements.

TASK

DS-04 Identifying V-belt drives

PERFORMANCE OBJECTIVE

Identify V-belt drives and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. V-belt drives
- b. Belt drive terminology
  - 1. Driver sheave
  - 2. Idler sheave
  - 3. Belt pitch length
  - 4. Sheave pitch diameter
  - 5. Arc of contact
  - 6. Center distance
  - 7. Speed ratio
- c. V-belt types and sizes
  - 1. Standard
  - 2. High capacity belts
  - 3. Light duty V-belts
- d. Special V-belts
  - 1. Double-angle or hex-shaped belts
  - 2. Group belts
  - 3. Endless type belts
- e. Timing belts
- f. Flat belts
- g. V-belt sheaves
- h. Timing belt pulleys
- i. Flat belt pulleys
- j. Variable speed pulleys
- k. Manually adjustable sheaves
- l. Spring loaded adjustable sheaves
- m. V-belt installation

Provide Demonstration On:

Installing a V-belt

Provide Practical Application On:

Select and install a V-belt.

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Maintenance Systems, Drive Components, Lesson Four

CLASSROOM HOURS

6

EVALUATION (DS-04)

Given an assignment to replace a V-belt, the student will select the appropriate type and size of belt and correctly install the belt. The completed task must comply with the instructor's specifications.

TASK

DS-05 Identifying chain drives

PERFORMANCE OBJECTIVE

Identify chain drives.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Chain drive purpose
b. Chain drive terminology
    1. Driver sprocket
    2. Chain pitch
    3. Center distance
    4. Chain length
    5. Chain rating
    6. Ultimate strength
    7. Pitch diameter
c. Roller chain drives
    1. Applications
    2. ASA roller chain numbers
    3. Construction
    4. Rollerless chains
d. Double-pitch chains
e. Leaf chains
f. Silent chain drives
g. Steel drive chains
    1. Straight side bar
    2. Offset side bar
h. Cast chain drives
i. Sprockets
    1. Hub classes
    2. Tapered keyways
    3. Single-duty and double duty sprockets for double pitch chains
j. Installing a chain drive

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Training Systems, Drive Components, Lesson Five

CLASSROOM HOURS 6

EVALUATION (DS-05)

Given a chain drive system, the student will select the appropriate chain and install the chain using procedures specified by the instructor.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:

Installing a chain on a chain drive system

Provide Practical Application On:

Install a chain on a chain drive system.

TASK

DS-06 Identifying speed reducers

PERFORMANCE OBJECTIVE

Identify speed reducers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Speed reducers
b. Reducer terminology
    1. Size
    2. Mechanical horsepower
    3. Thermal horsepower
    4. Overload capacity
    5. Service factor
    6. Gear ratio
    7. Single reduction units
    8. Double reduction units
    9. Triple reduction units
c. Concentric shaft reducers
    1. Mounted integrally with motor
    2. Helical cut gears
    3. Spur gears
    4. Planetary gears
d. Bearing support
    1. Snap ring
    2. Short shoulders
    3. Locking plates
    4. Oil seals
e. Parallel shaft reducers
f. Right angle shaft reducers
    1. Gearing
    2. Applications
g. Vertical shaft reducers
h. Types of speed reducers
    1. Shaft mounted
    2. Worm gear reducers
    3. Miter boxes
i. Installing a reducer
j. Reducer maintenance

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

a. Plant Engineering Training Systems, Drive Components, Lesson Six
b. Plant Engineering Training Systems, Drive Components, Lesson Seven

CLASSROOM HOURS

6

EVALUATION (DS-06)

Given a drive system requiring a reducer, the student will select and install the appropriate reducer according to the instructor's specifications.

Provide Demonstration On:

Installing a reducer

Provide Practical Application On:

Install a reducer.

TASK

DS-07 Identifying gears

PERFORMANCE OBJECTIVE

Identify gears and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Gear drives
b. Gear terminology
    1. Pitch diameter
    2. Diametral pitch
    3. Outside diameter
    4. Pressure angle
    5. Circular pitch
    6. Chordal thickness
    7. Addendum
    8. Dedendum
    9. Whole depth
    10. Working depth
    11. Face width
    12. Face of tooth
    13. Flank of tooth
    14. Back lash
c. Spur gears
d. Helical gears
    1. Helix angle
    2. Linear circular pitch
    3. Linear tooth thickness
    4. Linear pressure angle
e. Herringbone gears
f. Bevel gears
g. Worm gears
    1. Gear pitch diameters
    2. Worm pitch diameters
    3. Worm lead angle
    4. Worm lead
    5. Normal worm pitch
    6. Worm axial pitch
    7. Normal pressure angle
h. Gear maintenance

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Training Systems, Drive Components, Lesson Eight

CLASSROOM HOURS

6

EVALUATION (DS-07)

Given a drive system and specifications, the student will select the appropriate gears and install the gears using correct procedures.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:

Installing gears

Provide Practical Application On:

Install gears on a drive system.

TASK

DS-08 Identifying variable speed reducers

PERFORMANCE OBJECTIVE

Identify variable speed reducers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Variable speed reducers
   1. Applications
   2. Mechanical and electrical types
   3. Selection factors

b. Belt type variable speed drives
   1. Construction
   2. Operation
   3. Adjustment methods
   4. Belt types

c. Disc type variable speed drives

d. Roller type variable speed drives

e. Hydraulic variable speed drives

f. Electric variable speed drives

INSTRUCTIONAL MATERIALS

Textbooks:

Delmar, Electromechanical Technology Series, Drives

Student Manuals:

Plant Engineering Systems, Drive Components, Lesson Nine

CLASSROOM HOURS 6

EVALUATION (DS-08)

Given a drive system and specifications, the student will select a variable speed drive for the system. The selection must meet the instructor's specifications.

TASK

DS-09 Identifying brakes and motors

PERFORMANCE OBJECTIVE

Identify brakes and motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brakes and motors
b. Brakes
  1. Externally mounted
  2. Internally mounted
c. Friction shoe brakes
  1. Brake wheel coupling
  2. Construction
  3. Operation
d. Friction disc brakes
  1. Electrically operated
  2. Mounting
e. Magnetic brakes
  1. Types
  2. Applications
  3. Reversing starter
f. Motors
  1. A-C
  2. D-C
g. D-C motor types
  1. Shunt
  2. Series
  3. Compound wound
  4. Parts
h. A-C motor types
  1. Induction
  2. Synchronous
  3. Single-phase
  4. Multi-phase
  5. Polyphase
  6. Split-phase
  7. Capacitor start
i. Motor classification
j. Motor maintenance
  1. Lubrication
  2. Cleanliness

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Electromechanical Technology Series, Drives
b. Delmar, Electromechanical Technology Series, Devices

Student Manuals:

Plant Engineering Training Systems, Drive Components, Lesson Ten

CLASSROOM HOURS 23

EVALUATION (DS-09)

Given a drive system which has a motor and a brake, the student will identify and correctly describe the type of motor, brake and their operations.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:

Lubricating and cleaning a motor

Provide Practical Application On:

Lubricate and clean an electric motor.

TASK

B-01 Identifying principles of bearings and shafts

PERFORMANCE OBJECTIVE

Identify basic principles of bearings and shafts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bearing selection
  1. Bearing
  2. Spindle
  3. Factors in selection
b. Shafts and shafting
c. Shaft materials
d. Shaft stress
e. Other forces
f. Fits and clearances
g. Principles of bearing operation
h. Types of bearings

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Bearings, Lesson One

CLASSROOM HOURS 12

EVALUATION (B-01)

Given instruction in the basic principles of bearings and shafts, the student will correctly identify factors critical in making the selection for given applications.

TASK

B-02 Identifying plain journal bearings

PERFORMANCE OBJECTIVE

Identify plain journal bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Plain journal bearings
b. Advantages of plain journal bearings
c. Lubrication
d. Lubricating grooves
e. Seals
f. Types of plain journal bearings
g. Bearing design and selection
h. Characteristics of bearing
i. Bearing materials
j. Inspection of bearings
k. Bearing repair
l. Relining
m. Disassembly and reconditioning
n. Bearing installation

Provide Demonstration On:

a. Reconditioning a bearing
b. Installing a bearing

Provide Practical Application On:

Recondition a bearing and install it.

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

a. Plant Engineering Training Systems, Bearings, Lesson Two
b. Plant Engineering Training Systems, Bearings, Lesson Three

CLASSROOM HOURS

6

EVALUATION (B-02)

Given a plain journal bearing which is worn, the student will pull, recondition, re-groove and re-install the bearing. The completed work must comply with the instructor's specifications.

TASK

B-03 Identifying anti-friction bearings

PERFORMANCE OBJECTIVE

Identify anti-friction bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Anti-friction bearings
b. Operating principles
c. Bearing materials
d. Cage materials
e. Lubrication of anti-friction bearings
f. Seals and shields
g. Bearing classifications
h. Tolerances
i. Standard and precision bearings
j. Running accuracy
k. Bearing fits
l. Bearing design
m. Radial and axial
n. Fixed and floating bearings
o. Bearing fits
p. Squareness and alignment
q. Mounting methods
r. Mountings
s. Bearing selection

Provide Practical Application On:

Select the appropriate anti-friction bearing for a specified application.

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

a. Plant Engineering Training Systems, Bearings, Lesson Four
b. Plant Engineering Training Systems, Bearings, Lesson Five

CLASSROOM HOURS 6

EVALUATION (B-03)

Given specifications for an application requiring anti-friction bearings, the student will accurately select the appropriate size and type of bearing.

TASK

B-04 Identifying ball and roller bearings

PERFORMANCE OBJECTIVE

Identify ball and roller bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Difference between ball and roller bearings
b. Advantages over plain bearings
c. Ball bearings
d. Other types
e. Two-piece, inner-ring bearings
f. Fractured bearings
g. Bearing series
h. Roller bearings
i. Needle roller bearings

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
McGraw-Hill, Maintenance Engineering Handbook	Plant Engineering Training Systems, Bearings, Lesson Six

CLASSROOM HOURS 6

EVALUATION (B-04)

Given an overview of ball and roller bearing applications, the student will identify types of ball and roller bearings and describe their applications. The identification must comply with instructor's requirements.

TASK

B-05 Identifying specialized bearings

PERFORMANCE OBJECTIVE

Identify specialized bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thrust bearings
b. Self-aligning bearings
c. Linear-motion bearings
d. Pre-mounted bearings
e. Instrument bearings
f. Unground ball bearings
g. Powdered-metal bearings
h. Non-metallic bearings
i. Other materials
j. Hydrostatic bearings

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
McGraw-Hill, Maintenance Engineering Handbook	Plant Engineering Training Systems, Bearings, Lesson Seven

CLASSROOM HOURS

6

EVALUATION (B-05)

Given specifications for a special bearing application, the student will accurately identify and describe the type of bearing required.

TASK

B-06 Identifying bearing seals

PERFORMANCE OBJECTIVE

Identify bearing seals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of seals
b. Seal functions
c. Styles and types
d. Labyrinth seals
e. Oil seals
f. Oil seal classification
g. Special seals
h. Seal selection
i. Seal applications
j. "O" rings and mechanical seals

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Bearings, Lesson Eight

CLASSROOM HOURS 6

EVALUATION (B-06)

Given specifications for a seal application, the student will correctly identify the type of seal to use.

TASK

B-07 Identifying methods of bearing lubrication

PERFORMANCE OBJECTIVE

Identify methods of lubricating bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Lubrication practices
b. Functions of a lubricant
c. Lubricant selection factors
d. Oil lubrication
e. Grease lubrication
f. Special purpose
g. Packing bearings
h. Lubrication equipment

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Bearings, Lesson Nine

CLASSROOM HOURS 10

EVALUATION (B-07)

Given specifications for bearings which require lubrication, the student will accurately identify the appropriate method of lubrication.

TASK

B-08 Maintaining bearings

PERFORMANCE OBJECTIVE

Maintain bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bearing maintenance
b. Installing plain journal bearings
c. Installing anti-friction bearings
d. Mounting a bearing
e. Removing a bearing
f. Bearing loading patterns
g. Bearing failure
h. Cleaning a bearing

Provide Demonstration On:

a. Mounting a bearing
b. Removing a bearing
c. Cleaning a bearing

Provide Practical Application On:

Pull a bearing, clean and mount it. Test the machine for proper operation.

INSTRUCTIONAL MATERIALS

Textbooks:

McGraw-Hill, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Bearings, Lesson Ten

CLASSROOM HOURS 24

EVALUATION (B-08)

Given a machine with faulty bearings, the student will correctly identify the fault and pull, clean and replace the bearing. The bearing must be properly aligned and meet all industry requirements.

TASK

P-01 Identifying pump application

PERFORMANCE OBJECTIVE

Identifying applications of pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Water pumping systems
   1. Direct type
   2. Recirculating
b. Chemical pumping systems
c. Waste handling systems
d. High viscosity material pumping systems
e. Solids pumping system

Provide Practical Application On:

Identify the type of pumping system required for a specified material.

INSTRUCTIONAL MATERIALS

Textbooks:

Howard W. Sams and Co., Inc., Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson One

CLASSROOM HOURS

2

EVALUATION (P-01)

Given a specified substance to pump, the student will accurately identify and describe the type of pumping system required to efficiently pump the given substance.

TASK

P-02 Selecting a pump

PERFORMANCE OBJECTIVE

Select the appropriate pump for a system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pump problems
   1. Packings
   2. Seals
   3. Bearings
   4. Leaks
b. Pump terminology
   1. Suction lift
   2. Static suction lift
   3. Total dynamic suction lift
   4. Velocity head
   5. Suction head
   6. Static suction head
   7. Total dynamic
c. Pump terminology discharge side
   1. Total static head
   2. Total dynamic head
   3. Net positive suction head
   4. Specific gravity
d. Additional pump requirements
   1. Gallonage and viscosity of fluid
   2. Pump speed
   3. Altitude
   4. Abrasive material
e. System requirements that effect pump design

Provide Practical Application On:

Select a pump for a specified system.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Two

CLASSROOM HOURS 2

EVALUATION (P-02)

Given specifications for a system, the student will select a pump that has adequate capacity and speed to pump the substance. The instructor will check the student's choice.

TASK

P-03 Identifying centrifugal pumps

PERFORMANCE OBJECTIVE

Identify centrifugal pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Centrifugal pump applications
    1. Water or light fluid
    2. Can be adapted for heavy materials
b. Pump operation
c. Pump parts
    1. Casing
    2. Shaft
    3. Impeller
    4. Impeller vanes
    5. Impeller shrouds
    6. Pump suction
    7. Wearing rings
    8. A packing gland
    9. Diffusers
    10. Discharge point
d. Multi-stage pumps
e. Pump casings
f. Impellers
g. Wearing rings
h. Shafts

Provide Practical Application On:

Identify the parts of a centrifugal pump and describe how it operates.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Three

Tools and Equipment:

Centrifugal pumps and parts

CLASSROOM HOURS 2

EVALUATION (P-03)

Given a centrifugal pump, the student will identify the type of pump and correctly name the pump parts and their functions.

TASK

P-04 Identifying propeller and turbine pumps

PERFORMANCE OBJECTIVE

Identify a propeller or turbine pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Propeller pumps
b. Axial-flow pumps
    1. Application
    2. Above or below grade discharge points
    3. Diffuser vanes
    4. Steady bearings
c. Construction of propeller pumps
d. Mixed flow pumps
    1. Centrifugal errosion of water
    2. Operating speeds
    3. Enclosed vanes
    4. Casing size
e. Special propeller pump applications
    1. Location above water surface
    2. Large sump pump applications
f. Vertical turbine pump
    1. Applications
    2. Construction
g. Horizontal turbine pumps
    1. Regenerative pumps
    2. Applications
    3. Construction
    4. Relief valves

Provide Practical Application On:

On a system, identify the type of turbine or propeller pump and determine the direction of the flow.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, *Pumps*

Student Manuals:

Plant Engineering Training Systems, *Pumps, Lesson Four*

CLASSROOM HOURS

2

EVALUATION (P-04)

Given a system with a turbine or propeller pump, the student will accurately identify the type of pump and determine the direction of flow according to the instructor's satisfaction.

TASK

P-05 Identifying rotary pumps

PERFORMANCE OBJECTIVE

Identify rotary pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Rotary pumps
  - 1. Purpose
  - 2. Operation
- b. External gear pumps
  - 1. Operation
  - 2. Gear types
  - 3. Construction
- c. Internal gear pumps
  - 1. Outer gear
  - 2. Internal gear
  - 3. Crescent
- d. Helical screw gear pumps
  - 1. Operation
  - 2. Construction
- e. Vane type pumps
  - 1. Application
  - 2. Construction
- f. Flexible impeller pumps
  - 1. Used for chemical applications
  - 2. Construction
- g. Installing a rotary pump

Provide Demonstration On:

Installing a rotary pump

Provide Practical Application On:

Install a rotary pump on a system.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, *Pumps*

Student Manuals:

Plant Engineering Training Systems, *Pumps, Lesson Five*

Tools and Equipment:

- a. Rotary pump
- b. Mounting hardware
- c. Wrenches, screwdrivers and related tools

CLASSROOM HOURS

2

EVALUATION (P-05)

Given specifications for a job, the student will select and install the appropriate rotary pump on a system. The completed work must comply with the instructor's specification.

TASK

P-06 Identifying reciprocating pumps

PERFORMANCE OBJECTIVE

Identify reciprocating pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Reciprocating pump application
  - 1. Steam driven
  - 2. Pneumatic pumps
- b. Terminology
  - 1. Liquid section
  - 2. Steam on air section
  - 3. Piston and piston ring
  - 4. Cylinder
  - 5. Cylinder head
  - 6. Packing gland
  - 7. Connecting rod
  - 8. Valves
  - 9. Simplex pump
  - 10. Duplex pump
  - 11. Single acting pump
  - 12. Double-acting pump
  - 13. Triplex pump
- c. Calculating pump flow
- d. Steam-driven pumps
- e. Pumping section
  - 1. Valve plate
  - 2. Pot valve
  - 3. Renewable cylinder liners
- f. Driving section
- g. Rotary driven reciprocating pumps
  - 1. Power source
  - 2. Capacity

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Six

CLASSROOM HOURS

2

EVALUATION (P-06)

Given a reciprocating pump, the student will calculate the rate of flow of the pump in gallons per minute (gpm). The completed task must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

h. Horizontal plunger pumps
i. Vertical plunger pumps
j. Air driven pumps
k. Fluid section
l. Air sections

Provide Demonstration On:

Calculating pump flow in gpm

Provide Practical Application On:

Calculate the flow of a pump in gallons per minute (gpm).

TASK

P-07 Identifying metering pumps

PERFORMANCE OBJECTIVE

Identify metering pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Metering pump requirements
  - 1. Sensitivity to temperature
  - 2. Protection from internal damage
  - 3. Tolerances
- b. Metering pump classifications
  - 1. Plunger (or piston)
  - 2. Diaphragm
  - 3. Rotary
  - 4. Air cylinder operated
- c. Plunger pumps
  - 1. Applications
  - 2. Construction
  - 3. Metering adjustments
  - 4. Types of plunger pumps
- d. Diaphragm pumps
  - 1. Operation
  - 2. Methods of adjustment
  - 3. Types
- e. Rotary metering pumps
  - 1. Construction
  - 2. Method of metering flow
  - 3. Types
- f. Air cylinder-operated metering pumps
  - 1. Construction
  - 2. Operation
  - 3. Control mechanisms

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Seven

Tools and Equipment:

Several types of metering pumps

CLASSROOM HOURS 2

EVALUATION (P-07)

Given a metering pump, the student will accurately identify the pump and describe its operation.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Identify a metering pump as to the type and describe its operation.

TASK

P-08 Identifying special purpose pumps

PERFORMANCE OBJECTIVE

Identify special purpose pumps.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Handling difficult materials
b. Chemical pumps
c. Peristaltic pumps
    1. Tube peristaltic pumps
    2. Peristaltic screw pumps
    3. Applications
d. Non-sealing chemical pumps
e. Slurry pumps
f. Pulp handling pumps
g. Trash and sewage pumps
h. Diaphragm pump
    1. Operation
    2. Applications
i. Reciprocating slurry pumps
    1. Air or steam operated
    2. Motor or engine driven

Provide Practical Application On:

Determine the type of pump to use for a special purpose application.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Eight

CLASSROOM HOURS

2

EVALUATION (P-08)

Given specifications for a special purpose pumping job, the student will accurately identify the type of pump and the special requirements for its operation.

TASK

P-09 Installing packings and maintaining pumps seals

PERFORMANCE OBJECTIVE

Install packing and maintain seals on a pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Packing or seal requirements
b. Types of packing glands
    1. Solid packed stuffing box
    2. Sealing or injection type
    3. Internally or externally sealed
    4. Seal-ring cage
    5. Circulating packing gland
    6. Bleed-off gland
    7. Injection bleed off
    8. Smothering gland
c. Packing materials
    1. Cotton
    2. Asbestos
    3. Flax
    4. Aluminum and babbitt (for higher temperature)
    5. Synthetic types
d. Installing packing
e. Mechanical seals
    1. Rotating members
    2. Stationary members
    3. Construction: cartridge or separate
    4. Internal and external seals
    5. Balanced or unbalanced
f. Special seals
    1. Packingless seal
    2. Floating ring seal

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Training Systems, Pumps, Lesson Nine

CLASSROOM HOURS 5

EVALUATION (P-09)

Given a pump which requires replacement of packing or seal maintenance, the student will correctly install packing or maintain a seal according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Install packing in a pump.

TASK

P-10 Performing pump maintenance

PERFORMANCE OBJECTIVE

Perform pump maintenance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pump bearings
b. Journal bearings
c. Anti-friction bearings
d. Special bearings
e. Bearing lubrication
    1. Regular lubrication
    2. Using the proper lubricant
    3. Methods of lubrication
f. Bearing seals
g. Pump installation
h. Pump maintenance
i. Maintenance of centrifugal pumps
j. Maintenance of vertical turbine pumps
k. Rotary pump maintenance
l. Maintenance of difficult material pumps
m. Maintenance problems other than pump related

Provide Practical Application On:

Identify and perform maintenance on a pump.

INSTRUCTIONAL MATERIALS

Textbooks:

Black, Pumps

Student Manuals:

Plant Engineering Maintenance Systems, Pumps, Lesson Ten

CLASSROOM HOURS 3

EVALUATION (P-10)

Given a pumping system, the student will correctly identify and perform all maintenance required on the pumps and related parts. The completed task must comply with the instructor's specifications.

TASK

PS-01 Identifying piping systems and piping system maintenance

PERFORMANCE OBJECTIVE

Identify piping systems and related maintenance requirements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Piping systems
   1. Purpose of piping system
   2. Types of piping systems
b. Fluids
c. Purpose of components
   1. Keep the fluid moving
   2. Keep the fluids in good condition
d. Maintenance
   1. Blow-off valves
   2. Clean out plugs
e. Valves and fittings
f. Pipe hanging and support
g. Temperature effects
h. Piping insulation
i. Maintenance considerations of piping systems
   1. Corrosion and leakage
   2. Valves
   3. Insulation
   4. Installing new piping, tubing, hoses
   5. Fittings
   6. Hangers and pipe supports
   7. Cleaning pipe
   8. Extending existing system as needed

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumbers and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson One

Tools and Equipment:

Pipefitter's tools

CLASSROOM HOURS 2

EVALUATION (PS-01)

Given a piping system, the student will inspect the system and perform routine maintenance as necessary. The completed task must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Inspect a piping system and perform routine maintenance as necessary.

TASK

PS-02 Maintaining metal pipe

PERFORMANCE OBJECTIVE

Maintain metal pipe on a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pipes
   1. Outside diameter
   2. Inside diameter
   3. Wall thickness
   4. Length
   5. Weight per foot
b. Pipe schedules
   1. Standard
   2. Extra-strong
   3. Double extra-strong
c. Other pipe codes
d. Types of system
   1. Process lines
   2. Utility or service lines
e. Identification of pipe lines
   1. Color
   2. Stenciled or painted letters
   3. Tags or Nameplates
f. Metal piping
g. Characteristics of metals
h. Pipe manufacturing methods
i. Behavior of fluids in piping
j. Piping applications
k. Steam piping
l. Water piping
m. Maintenance considerations
   1. Effects of temperature changes
   2. Outside material in the lines
   3. Shifting of pipe supports
   4. Corrosion
   5. Water hammer

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Audel, Plumber's and Pipefitter's Library
ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Basic Plumbing Skills"

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Two

Tools and Equipment:

a. Pipe
b. Dies
c. Wire brush
d. Pipe compound or "dope"

CLASSROOM HOURS

2

EVALUATION (PS-02)

Given a piping system, the student will select the appropriate size pipe, thread the pipe and replace the section according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

n. Joining pipe
    1. Bell and spigot
    2. Welded
    3. Soldered or brazed
    4. Screwed
    5. Forged

Provide Demonstration On:

Threading pipe

Provide Practical Application On:

Choose the proper size pipe and thread the pipe to replace a section.

TASK

PS-03 Maintaining non-metallic piping

PERFORMANCE OBJECTIVE

Maintain non-metallic piping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of non-metallic pipe
   1. Clay
   2. Concrete
   3. Plastic
   4. Glass
   5. Wood
b. Clay pipe
   1. Vitrified
   2. Unglazed
c. Concrete pipe
   1. Non-reinforced concrete
   2. Reinforced concrete
   3. Reinforced and prestressed concrete pressure pipe - cylinder pipe
   4. Asbestos - cement pipe
c. Plastic piping
   1. High corrosion resistance
   2. Self-insulating
   3. Freedom from rust and rot
   4. Lightweight
   5. Ease of joining
d. Thermoplastic piping
   1. PUC (polyethylene chloride)
   2. PEC (Polyethylene)
   3. ABS (Acrylonitrile - butadine - styrene)
   4. CAB (Cellulose - acetate - butyrate)
e. Thermosetting plastics
   1. Epoxy piping
   2. Polyester piping

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumber's and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Laboratory Exercises in Pipefitting"

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Three

Tools and Equipment:

a. PUC, ABS or CAB pipe
b. Solvent
c. Brush
d. Sandpaper

CLASSROOM HOURS

2

EVALUATION (PS-03)

Given a piping system requiring a section replacement, the student will join a new section of piping using the appropriate solvent. The completed task must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

f. Limitations of plastic piping
g. Joining plastic piping
h. Plastic piping maintenance
i. Glass piping
j. Other piping materials
    1. Chemical porcelain
    2. Chemical stoneware
    3. Wooden pipe
    4. Cast iron and steel

Provide Demonstration On:

Joining plastic pipe by solvent welding

Provide Practical Application On:

Using solvent, replace a section of plastic pipe on a piping system.

TASK

PS-04 Maintaining tubing

PERFORMANCE OBJECTIVE

Maintain tubing in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tubing
    1. Classifying tubing
    2. Birmingham Wire Gage (BWG)
    3. Tubing applications
b. Advantages of tubing
    1. Tight spaces
    2. Flexibility
    3. Laminar flow
c. Joining tubing
d. Types of tubing
    1. Copper
    2. Steel
    3. Stainless steel
    4. Aluminum
e. Tubing applications
f. Plastic tubing
g. Tubing maintenance

Provide Demonstration On:

a. Bending tubing
b. Soldering tubing

Provide Practical Application On:

Bend tubing and solder a joint.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumbers and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Laboratory Exercises in Pipe Fitting"

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Four

Tools and Equipment:

a. Tubing
b. Tube cutter
c. Deburring tool
d. Wire brush or emery cloth
e. Flaring tool

(Continued on back)

CLASSROOM HOURS 2

EVALUATION (PS-04)

Given a piping system requiring a section of copper tubing, the student will follow appropriate procedures to bend and solder the tubing joints to lengths and bends. All work must comply with the instructor's specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. Solder
g. Torch
h. Tube bender
i. Flux

TASK

PS-05 Maintaining hoses

PERFORMANCE OBJECTIVE

Maintain hoses in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Hoses
  - 1. Applications
  - 2. Vibration dampening effect
- b. Codes and sizes
- c. Hose classifications
  - 1. Non-metallic
  - 2. Non-metallic reinforced
  - 3. Metallic
- d. Hose terminology
  - 1. Enlarge or expanded
  - 2. Tube
  - 3. Reinforcement
  - 4. Mandrel braided
  - 5. Cover
  - 6. Overall length
  - 7. Vacuum rating
- e. Non-metallic - reinforced hose
  - 1. Vertical and horizontal braiding
  - 2. Horizontal braided - wire reinforced
  - 3. Wrapped hose
  - 4. Wire reinforced
  - 5. Wire woven
- f. Non-metallic hose
- g. Metallic hoses
  - 1. Bronze braided
  - 2. Applications
- h. Hose couplings
  - 1. Anchor coupling
  - 2. Clamping

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Audel, Plumber's and Pipefitter's Library
- b. ATS, How to Design and Install Plumbing

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Five

Tools and Equipment:

- a. Hoses
- b. Couplings
- c. Pliers
- d. Clamps

CLASSROOM HOURS 2

EVALUATION (PS-05)

Given a piping system, the student will select the proper size hose, install a coupling and install the hose in the system according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

3. Guide disconnect
i. Maintenance of hoses

Provide Demonstration On:

Installing coupling on hoses

Provide Practical Application On:

Install a coupling and join a piece of hose to a piping system.

TASK

PS-06 Maintaining fittings

PERFORMANCE OBJECTIVE

Maintain fittings in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Fittings
   1. Steel, bronze, cast iron, plastic, glass
   2. Standards
b. Functions of fittings
   1. Change direction of flow.
   2. Providing branch connections
   3. Change size of lines
   4. Close lines
c. Connecting fittings
   1. Screwed
   2. Flanged
   3. Welded
d. Other fittings
   1. Expansion joints
   2. Vibration dampeners
e. Welding fittings
f. Tubing fittings
   1. Flared
   2. Compression
   3. Brazed-seal tube

Provide Practical Application On:

Choose a fitting and correctly connect tubing.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumber's and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Laboratory Exercise in Pipefitting"

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Six

Tools and Equipment:

a. Tubing
b. Fittings
c. Flaring tool
d. Wrenches

CLASSROOM HOURS 2

EVALUATION (PS-06)

Given tubing which requires connection, the student will choose the appropriate fitting and correctly connect the tubing. Work must comply with the instructor's specifications.

TASK

PS-07 Maintaining common valves.

PERFORMANCE OBJECTIVE

Maintain common valves in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Valves
   1. Purpose
   2. Construction
   3. Sizes
b. Valve functions
   1. Throttling
   2. Regulating
c. Types of industrial valves
   1. Ball
   2. Globe
   3. Gate
   4. Butterfly
   5. Plug
   6. Needle
   7. Check
   8. Quick-opening
d. Parts of a valve
   1. Body
   2. Bonnet
   3. Trim
e. Types of check valves
   1. Horizontal list
   2. Vertical list
   3. Ball check
   4. Foot valve
   5. Swing check
f. Valve maintenance
   1. Galling
   2. Seizing
   3. Leaks
g. Valve connections

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumber's and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Laboratory Exercises in Pipefitting"

Student Manuals:

Plant Engineering Training System, Piping Systems Lesson Seven

Tools and Equipment:

a. Seals
b. Valves
c. Wrenches

CLASSROOM HOURS 2

EVALUATION (PS-07)

Given a leaky valve, the student will disassemble the valve, replace the appropriate seals, reassemble the valve. The completed task must be free of leaks and within instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:

Replacing seals in a valve

Provide Practical Application On:

Replace seals in a valve.

TASK

PS-08 Identifying specialized valves

PERFORMANCE OBJECTIVE

Identify specialized valves in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Construction and materials
b. Diaphragm valves
c. Blowoff valves
    1. Use boiler pressure to blow off boiler water.
    2. Lower water level in boiler.
    3. Clear the boiler after cleaning.
    4. Types - seatless sliding plunger, sliding disc, seat-and-disc
d. Pressure regulator valves
    1. Main valve and piston assembly
    2. Auxiliary valve assembly
e. Temperature regulating valves
f. Safety valves
g. Relief valves
    1. Rupture disc relief valves
    2. Pressure reducing valves
h. Other valve types
    1. By-pass valves
    2. Float valve
    3. Pilot valve
    4. Slurry valve
i. Valve operators
    1. Actuators
    2. Operators
    3. Magnetic operators
    4. Pneumatic and hydraulic operators
    5. Remote control

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumber's and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Eight

CLASSROOM HOURS 1

EVALUATION (PS-08)

Given a piping system, the student will accurately identify specialized valves used in the system and describe their purpose.

TASK

PS-09 Maintaining strainers, filters and traps

PERFORMANCE OBJECTIVE

Maintain strainers, filters and traps in a piping system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Strainers
   1. Construction
   2. Uses
b. Magnetic ferrous trap
c. Filters
   1. Change fluid direction and trap contaminants
   2. Duplex filter
   3. Edge-type filter
   4. Cartridge-type filter
d. Steam
e. Traps
   1. Purpose
   2. Thermostatic traps
   3. Mechanical traps
f. Mechanical traps
   1. Float-and-thermostatic
   2. Float
   3. Inverted bucket
   4. Upright bucket
g. Vent valves
   1. Purpose
   2. Vacuum vent valve
h. Trap maintenance
   1. Removing sludge
   2. Adjusting mechanical linkage
   3. Reseating valves
   4. Troubleshooting a faulty trap
   5. Safety

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Audel, Plumbing and Pipefitter's Library
b. ATS, How to Design and Install Plumbing

A/Vs:

Hobar, "Laboratory Exercises in Pipefitting"

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Nine

Tools and Equipment:

a. Wrenches
b. Protective gloves

CLASSROOM HOURS	5

EVALUATION (PS-09)

Given a piping system with a defective trap, the student will troubleshoot the trap and accurately correct the defect. The student must observe all safety requirements and the completed work must comply with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:

Troubleshoot a faulty trap.

Provide Practical Application On:

Troubleshoot and repair a faulty trap.

TASK

PS-10 Maintaining pipeline by monitoring accessories

PERFORMANCE OBJECTIVE

Maintain pipeline by monitoring accessories.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pressure gages
    1. Purpose
    2. Gage pressure (psig)
    3. Absolute pressure (psia)
    4. Spring loaded gages
    5. Bourdon tube types
    6. Bellow gage
    7. Plunger gage
b. Temperature gages
    1. Bimetallic gages
    2. Coefficient of expansion
    3. Thermostats
    4. Recording thermometer
c. Rotary pressure joints
d. Sight-flow indicator
e. Vacuum breakers
f. Accumulators
g. Receivers
h. Actuators and intensifiers
    1. Linear actuators
    2. Single-or double-acting
    3. Intensifier
i. Pneumatic pressure line accessories
    1. Filter regulator
    2. Lubricator
    3. Air-line lubricator
j. Heat exchangers

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Audel, Plumber's and Pipefitter's Library

Student Manuals:

Plant Engineering Training Systems, Piping Systems, Lesson Ten

Tools and Equipment:

Pipefitter's wrenches

CLASSROOM HOURS

4

EVALUATION (PS-10)

Given a pipeline with gages and other accessories, the student will monitor the flow and pressure for proper operation and repair the system as necessary. The student will use the appropriate pipefitter's wrench in the correct manner. The completed task must be in compliance with the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

k. Wrenches
    1. Monkey wrench
    2. Strap wrench
    3. Pipe wrench
    4. Pipe tongs
    5. Open-end wrenches
    6. Proper use of wrenches

l. Maintenance
    1. Preventive maintenance
    2. Repair maintenance

Provide Demonstration On:

Proper use of pipefitter's wrenches

Provide Practical Application On:

Monitor gages and other accessories to maintain a pipeline. Repair the line if necessary.

TASK

BH-01 Identifying principles of hydraulics

PERFORMANCE OBJECTIVE

Identify principles of hydraulics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Fluid power systems
    1. Pnuematics
    2. Hydraulics
b. Force
c. Weight
d. Mass
e. Pressure
    1. Atmospherie
    2. Hydraulic
f. Work
g. Power
h. Types of energy used in hydraulic systems
    1. Electrical
    2. Hydraulic
    3. Kinetic
    4. Potential energy
    5. Heat energy
i. Incompressible liquids
j. Non-diffusion
k. Hydrostatic pressure
l. Pascal's Law
m. Transmission of fluid power
n. Fluid flow in pipes
    1. Stream line
    2. Turbulent
    3. Cavitation
o. Bernoulli's Principle
p. The effect of heat on liquids
q. Hydraulic power system
    1. Pump
    2. Control valve
    3. Activating unit
    4. Hydraulic fluid
    5. Piping or tubing
r. Modified base hydraulic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Howard W. Sams and Co., ABC's of Hydraulic Circuits
c. Pippenger and Hicks, Industrial Hydraulics
d. Delmar, Electromechanical Technology Series, Fluids

A/Vs:

Howard W. Sams and Co., "Fluid Power Transparency Masters"

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics, Lesson One
b. Oregon, IM-HY-02, Ils

CLASSROOM HOURS

5

EVALUATION (BH-01)

Given an over view of basic hydraulics principles and terms, the student will identify the principles and describe the components of a basic hydraulic system. The completed task must be rated as acceptable according to the instructor's specifications.

TASK

BH-02 Identifying hydraulic fluids

PERFORMANCE OBJECTIVE

Identify hydraulic fluids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functions of hydraulic fluids
b. Physical properties of hydraulic fluids
c. Viscosity
    1. Saybolt Universal Seconds (SUS)
    2. American Society for Testing Materials (ASTM)
    3. Viscosity and pressure
d. Pour point
e. Fluid selection
f. Effects of too low/too high fluid levels
g. Component protection
h. Chemical properties
i. System contamination
i. System contamination
    1. Water - demulsification, vapor pressure
    2. Dissolved air
    3. Foaming
    4. Corrosion and rusting
j. Hydraulic fluid types
    1. Petroleum oils
    2. Oil-in-water emulsions
    3. Water-in-oil emulsions
    4. Water base glycols
    5. Chlorinated hydro-carbons
    6. Phosphate esters
    7. Silicones
    8. Silicate esters

Provide Practical Application On:

Identify types of hydraulic fluids.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Two

Tools and Equipment:

Examples of types of hydraulic fluid

CLASSROOM HOURS 5

EVALUATION (BH-02)

Given a hydraulic fluid, the student will describe the fluid in terms of viscosity, chemical properties and fluid type. The completed task must be rated as acceptable according to the instructor's specifications.

TASK

BH-03 Identifying strainers and filters in hydraulic systems

PERFORMANCE OBJECTIVE

Identify strainers and filters in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Hydraulic system requirements
- b. Removing contaminates
- c. Degree of filtration
  - 1. Norminal
  - 2. Absolute
  - 3. Particle
- d. Performance characteristics
- e. Performance of different mediums
  - 1. Surface mediums
  - 2. Depth types
- f. Strainers
  - 1. Mesh
  - 2. Primary use
  - 3. Reservoir strainers
  - 4. In line strainers
- g. Filters
- h. Fiber mediums
- i. Magnetic mediums
- j. Filter and strainer installations

Provide Practical Applications On:

Identify several types of filters and strainers.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Pippenger and Hicks, Industrial Hydraulics
- c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Three

Tools and Equipment:

Several types of filters and strainers

CLASSROOM HOURS 5

EVALUATION (BH-03)

Given a selection of filters and strainers, the student will identify and describe each type and its function. The completed task must meet the instructor's specifications.

TASK

BH-04 Identifying reservoirs and accumulators in a hydraulic system

PERFORMANCE OBJECTIVE

Identify reservoirs and accumulators in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. System demands
  1. Function of a reservoir
  2. Function of an accumulator
b. Fluid reservoir requirements
  1. Store a supply of hydraulic fluid
  2. Break up foam
  3. Settle heavy dirt, sludge and water
  4. Cool the fluid
  5. Mounting platform for pump and other equipment
c. Baffles
d. Air separation
e. Reservoir cooling
f. Liquid heat exchanger
g. Reservoir accessories
  1. Pump intake strainers
  2. Suction gage
  3. Air breather
  4. Fluid level gage
  5. Thermometer
  6. The reservoir as support base for the power unit
h. Accumulators
  1. Stores fluid under pressure until needed by system
  2. Absorbs hydraulic shocks

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulic, Lesson Four
b. Oregon, Reservoirs

Tools and Equipment:

Hydraulic system (or diagram)

CLASSROOM HOURS 5

EVALUATION (BH-04)

Given a hydraulic system, the student will identify reservoirs and accumulators and describe their purposes. The completed task must be rated as acceptable according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:
continued

i. Types of accumulators
  1. Weight loaded or gravity
  2. Spring-loaded piston
  3. Air bottle or non-separated gas
  4. Bladder or bag
  5. Diaphragm
  6. Gas charged piston
  7. Differential piston

TASK

BH-05 Identifying hydraulic pumps on a system

PERFORMANCE OBJECTIVE

Identify pumps on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of hydraulic pumps
b. Pump classifications
    1. Positive displacement
    2. Non-positive displacement
    3. Fixed or variable displacement
    4. Rotary
    5. Piston
    6. Radial piston
c. Rating selection factors
    1. Capacity
    2. Pressure
    3. Drive speed
    4. Efficiency
    5. Reliability
    6. Fluid characteristics
    7. Size and weight
    8. Control adaptability
    9. Life
    10. Installation and maintenance
d. Gear pumps
    1. External
    2. Internal
    3. Axial flow or screw
    4. Cycloidal
e. Vane pumps
f. Piston pumps
    1. Dexial piston
    2. Radial pistons
    3. Inlet and outlet check valve

Provide Practical Applications On:

Identify types of pumps from live examples, illustrations or diagrams.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals

a. Plant Engineering Training Systems, Basic Hydraulics, Lesson Five
b. Oregon, Pumps

Tools and Equipment:

Pumps (live examples illustrations or diagrams)

CLASSROOM HOURS

5

EVALUATION (BH-05)

Given diagrams of pumps, the student will accurately identify the type of pump and describe its use.

TASK

BH-06 Identifying piping, tubing and fittings

PERFORMANCE OBJECTIVE

Identify piping, tubing and fittings used in hydraulic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hydraulic piping
b. Flow and velocity
    1. Laminar flow
    2. Velocity = $\frac{\text{flow (gpm)} \times 0.321}{\text{pipe area (sq. in.)}}$
c. Hydraulic pressure
d. Pressure loss
e. Pipe fittings
f. Threaded pipe
g. Installing pipe
h. Tubing
    1. Tube bending
    2. Tube fittings
i. Hoses

Provide Practical Application On:

Choose the correct size pipe, fitting, coupling or hose for a job.

INSTRUCTIONAL MATERIALS

Text books:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Six

Tools and Equipment:

a. Pipe
b. Tube
c. Fittings
d. Hoses
e. Tools for pipe fitting

CLASSROOM HOURS

5

EVALUATION (BH-06)

Given specifications for a job, the student will select the correct size pipe, fitting, coupling or hose and prepare the job for installation. The completed task must be in accordance with the instructor's specifications.

TASK

BH-07 Identifying directional control valves

PERFORMANCE OBJECTIVE

Identify directional control valves used in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information on:

- a. Purpose of directional control valves
- b. Manually operated valves
  - 1. Globe
  - 2. Plug
  - 3. Ball
  - 4. Needle
- c. Automatic two-way valves
  - 1. Direct-acting
  - 2. Normally closed
  - 3. Pilot operated
- d. Check valves
- e. Spool valves
- f. Fluid motor control
- g. Normally open and normally closed three-way valves
- h. Holding valves
- i. Four-way valves
- j. Five-way valves
- k. Rotary valves
- l. Valve actuators
- m. Special valves and accessories

Provide Practical Application On:

Identify types of directional control valves on a diagram of a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, *Basic Fluid Power*
- b. Pippenger and Hicks, *Industrial Hydraulics*
- c. Delmar, *Electromechanical Technology Series, Fluids*

Student Manuals:

- a. Plant Engineering Training Systems, *Basic Hydraulics, Lesson Seven*
- b. Oregon, *Directional Control Valve*

Tools and Equipment:

Diagram of a hydraulic system

CLASSROOM HOURS

5

EVALUATION (BH-07)

Given a diagram of a hydraulic system, the student will accurately identify the types of directional control valves on the system using the diagram.

TASK

BH-08 Identifying pressure control valves

PERFORMANCE OBJECTIVE

Identify pressure control valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pressure control valves
   1. Purpose
   2. Flow control
   3. Holding or sequence valve
b. Pressure relief valve
   1. Poppet or spool type
   2. Flow capacity
   3. Operating differential pressure
c. Spool valves
   1. Simple and direct acting spool valve
   2. Two-stage or compound
   3. Remote control
d. Sequence valves
e. Counter balance valves
f. Holding valves
g. Unloading valves
h. Pressure reducing valves
i. Shock suppressors
j. Flow control valves
k. Pressure compensation
l. Temperature compensation

Provide Practical Application On:

Identify and describe types of pressure control valves from illustrations or live examples.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics Lesson Eight
b. Oregon, Pressure Relief Valves

CLASSROOM HOURS 5

EVALUATION (BH-08)

Given illustrations or live examples of pressure control valves, the student will correctly identify the type of valve and describe its purpose.

TASK

BH-09 Identifying cylinders in a hydraulic system

PERFORMANCE OBJECTIVE

Identify cylinders used in a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of cylinders
b. Double-acting cylinders
c. Single-acting cylinder
    1. Ram
    2. Telescoping cylinders
d. Two-piston cylinders
e. Positional cylinders
f. Cylinder construction
    1. Piston rings and seals
    2. Road packing
g. Cylinder mounting
    1. Fixed
    2. Pivoted
    3. Centerline
    4. Non-centerline
h. Selecting a cylinder
i. Flow capacity
j. Cushioning
k. Piston rod strength

Provide Practical Application On:

Select the appropriate cylinder for a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Morrow, Maintenance Engineering Handbook
d. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

a. Plant Engineering Training Systems, Basic Hydraulics Lesson Nine
b. Oregon, Cylinders

Tools and Equipment:

Cylinders

CLASSROOM HOURS 5

EVALUATION (BH-09)

Given specifications for a system which requires a cylinder, the student will select an appropriate cylinder for the system. The selection will be rated according to the instructor's specifications.

TASK

BH-10 Identifying hydraulic motors

PERFORMANCE OBJECTIVE

Identify hydraulic motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of hydraulic motors
b. Classification of motors
   1. Positive displacement
   2. Fixed displacement
   3. Variable displacement
c. Rating and selection factors
   1. Pressure range
   2. Speed range
   3. Torque
   4. Horsepower
   5. Overall efficiency
   6. Volumetric efficiency
   7. Size, weight and mounting requirements of motor
   8. Reliability and service life
d. Hydraulic motor construction
e. Gear motors
   1. External
   2. Internal
   3. Non-separated
f. Vane motors
g. Piston motors
h. Rotary actuators

Provide Practical Application On:

Select an appropriate motor for a system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics
c. Morrow, Maintenance Engineering Handbook
d. Delmar, Electromechanical Technology Series, Fluids

Student Manuals:

Plant Engineering Training Systems, Basic Hydraulics, Lesson Ten

Tools and Equipment:

Hydraulic motors

CLASSROOM HOURS

7

EVALUATION (BH-10)

Given specifications for a system and considering all rating factors, the student will select an appropriate motor. The selection will be rated by the instructor according to industry specifications.

TASK

THS-01 Troubleshooting hydraulic systems schematics

PERFORMANCE OBJECTIVE

Troubleshoot a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of a hydraulic system
    1. Pump and drive units
    2. Actuators
    3. Control valves
    4. Conductors and connectors
    5. Hydraulic fluid
    6. Fluid storage and conditioning equipment
b. Tracing the system
    1. Getting to know the system
    2. Circuit and system diagrams
c. Mechanical set-up
d. Understanding components
e. System operation

Provide Practical Application On:

Using a schematic, troubleshoot a hydraulic system for a particular problem.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippinger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson One

Tools and Equipment:

Schematics of a hydraulic system

CLASSROOM HOURS

10

EVALUATION (THS-01)

Given a schematic of a hydraulic system, the student will trace the system to troubleshoot a given problem. The completed task must be in compliance with the instructor's specifications.

TASK

THS-02 Reading hydraulic schematic diagrams

PERFORMANCE OBJECTIVE

Read a hydraulic schematic diagram.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of hydraulic diagrams
b. What is a schematic?
c. Characteristics of schematics
d. Guidelines for reading schematics
    1. Look for flow pattern.
    2. Look for guides.
    3. Read carefully.
    4. Use a step-by-step approach.
e. Basic elements of a hydraulic system
    1. Pumps
    2. Control valves
    3. Conductors and connectors
    4. Fluid storage and conditioning equipment
    5. A hydraulic circuit
f. Sequence valve circuit

Provide Practical Application On:

Read and interpret a schematic of a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Two

CLASSROOM HOURS 10

EVALUATION (THS-02)

Given a schematic diagram of a hydraulic system, the student will interpret the system according to the instructor's specifications.

TASK

THS-03 Installing hydraulic components

PERFORMANCE OBJECTIVE

Install components of a pump and a control valve on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Installation considerations
    2. Cleanliness
    2. Installation safety
b. Pump and drive installations
    1. Rigid mounting
    2. Styles of pumps
c. Pump start-up
    1. Checking the pump
    2. Cleanliness
    3. Proper direction of rotation
    4. Correct fluid
    5. Start pump
    6. Purge air after 5 minutes
d. Final pump start-up check
    1. Check joints for leakage
    2. Fluid level in reservoir
    3. Fluid temperatures
    4. System pressure
    5. Spongy operation
e. Control valve installation
    1. Sub-plate connections
    2. In line threaded connections
    3. In line flanged connections
    4. Manifold
f. Extra valve ports for convenience
g. Valve port identification
h. Mechanical valve installation

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Three

Tools and Equipment:

a. Pump
b. Control valve
c. Tools
d. Schematic

CLASSROOM HOURS

10

EVALUATION (THS-03)

Given appropriate tools and equipment, the student will properly install a pump and control valve on a hydraulic system. The installation must meet the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Pneumatically actuated valves
j. Electrically controlled valves

Provide Practical Application On:

Install a pump and a control valve on a hydraulic system.

TASK

THS-04 Installing pipes and tubes

PERFORMANCE OBJECTIVE

Install pipes, tubes and hoses on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conductors and connectors
   1. Pipes
   2. Tubes
   3. Hoses
b. Hydraulic pipe
c. General installation procedures
   1. Do not overtighten tapered connections.
   2. Do not weld a fitting attached to a component.
   3. Always use full size pipe or fittings for a component.
   4. Never turn fittings on pipe to put tension or compression on the connector.
   5. Provide support for components.
   6. Count tools when installation is finished.
d. Hydraulic tubing
   1. Cutting the tube
   2. Deburring
   3. Tube flaring
   4. Tube bending
   5. Assembling the tube
e. Hydraulic hose
f. Seal installation
g. Reservoir installation
h. Filter installation
i. Cooler and heat exchange installation
j. Actuator installation

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Four

Tools and Equipment:

a. Pipes
b. Tubes
c. Fittings and couplings
e. Tools

CLASSROOM HOURS 8

EVALUATION (THS-04)

Given an assignment to install pipes, tubes or hoses on a hydraulic system, the student will follow correct procedure for the installation. The procedure must be rated acceptable according to the instructor's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

Install pipes, tubes or hoses on a hydraulic system.

TASK

THS-05 Selecting hydraulic fluids

PERFORMANCE OBJECTIVE

Select hydraulic fluids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Hydraulic fluid selection criteria
  - 1. Lubricating properties
  - 2. Viscosity and viscosity index
  - 3. Resistance to chemical and physical changes
  - 4. Low temperature properties
  - 5. Demulsibility
  - 6. Anti-rust properties
  - 7. Fire-resistance
  - 8. Compatibility
  - 9. General properties
- b. Selection of fluid
- c. Filling the system
- d. Filter installation

Provide Demonstration On:

Filling a system with fluid

Provide Practical Application On:

Select hydraulic fluid, fill the system and install a new filter.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Pippenger and Hicks, Industrial Hydraulics
- c. Morrow, Maintenance Engineering Handbook

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Five

Tools and Equipment:

- a. Hydraulic fluid
- b. Filter
- c. Tools

CLASSROOM HOURS 6

EVALUATION (THS-05)

Given a hydraulic system, the student will select the appropriate fluid, fill the system to the correct level and change the filter. All completed tasks must comply with the instructor's specifications.

TASK

THS-06 Planning system maintenance

PERFORMANCE OBJECTIVE

Plan the maintenance of a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Classifying maintenance
    1. Service
    2. Inspection
    3. Repair
    4. Reconditioning
    5. Testing
b. Inspection
c. Organize the maintenance
    1. Identify each system.
    2., Keep a file for maintenance records.
d. Maintenance requirements
e. Regular inspections
f. Reservoir fluid level
g. Reservoir fluid temperature
h. External leaks
i. External condition of system
j. Operating pressure
k. Fluid quality
l. Filters
m. Machine performance
n. Repair planning
o. Reconditioning planning
p. System servicing

Provide Practical Application On:

Develop a maintenance plan for a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Six

CLASSROOM HOURS 5

EVALUATION (THS-06)

Given a hydraulic system, the student will plan a maintenance schedule which includes inspection, servicing and overhauling. The system must meet the instructor's specifications.

TASK

THS-07 Troubleshooting hydraulic systems (diagnostic technique)

PERFORMANCE OBJECTIVE

Troubleshoot a hydraulic system and diagnose the problem.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What is troubleshooting?
   1. Diagnosis and symptoms
   2. Evaluating maintenance history
   3. Evaluating symptoms
   4. Determining the cause
   5. Identifying the solution
b. Tools and gages
   1. Wrenches
   2. Gages
c. Applying troubleshooting procedures

Provide Practical Application On:

Troubleshoot a hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Seven

Tools and Equipment:

a. Tools
b. Gages
c. Maintenance history records

CLASSROOM HOURS

10

EVALUATION (THS-07)

Given a defective hydraulic system and appropriate tools, gages and maintenance records, the student will troubleshoot the system and correctly diagnose the problem according to the instructor's specifications.

TASK

THS-08 Troubleshooting valves

PERFORMANCE OBJECTIVE

Troubleshoot valves on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Valve problems
   1. Excessive leakage
   2. Sticking or jamming
   3. Bad controller element
   4. Cracked or broken parts
   5. Distorted or broken springs

b. Valve test procedures

c. Repair procedure
   1. Disassembly
   2. Cleaning
   3. Inspection
   4. Repair or replace
   5. Reassembly
   6. Setting to specifications
   7. Testing

d. Solenoid problems
   1. Melted insulation
   2. Physical destruction

Provide Practical Application On:

Troubleshoot and repair a faulty valve.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Eight

Tools and Equipment:

a. Valves
b. Tools
c. Parts
d. Gages

CLASSROOM HOURS

5

EVALUATION (THS-08)

Given a valve with a defect and appropriate tools, gages and parts, the student will troubleshoot and repair the valve according to the instructor's specifications.

TASK

THS-09 Troubleshooting cylinders

PERFORMANCE OBJECTIVE

Troubleshoot cylinders on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Description of cylinders
b. Troubleshooting a cylinder
c. Cylinder testing
d. Cylinder repair
e. Shock absorbers
f. Safety

Provide Practical Application On:

Troubleshoot and rapair a cylinder.

INSTRUCTIONAL MATERIALS

Testbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Nine

Tools and Equipment:

a. Cylinders
b. Tools and gages

CLASSROOM HOURS

10

EVALUATION (THS-09)

Given a defective cylinder and appropriate tools and gages, the student will troubleshoot the cylinder, repair the problem and re-install the cylinder according to the instructor's specifications.

TASK

THS-10 Troubleshooting pumps and motors

PERFORMANCE OBJECTIVE

Troubleshoot pumps and motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pumps and motors
   1. Gear
   2. Vane
   3. Axial
   4. Radial
b. Troubleshooting test for
   1. Pressure
   2. Flow
   3. Temperature
c. Gear pump problems
   1. Contamination
   2. Proper fluid conditions
   3. Cavitation
   4. Bearing and shaft wear
d. Vane pump problems
e. Vane motors
f. Axial piston pump problems
g. Radial piston pump problems
h. Pump and motor repair
i. Pump maintenance checks

Provide Practical Application On:

Troubleshoot a hydraulic system for a pump or motor problem and repair the defective parts.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Pippenger and Hicks, Industrial Hydraulics

Student Manuals:

Plant Engineering Training Systems, Hydraulic Troubleshooting, Lesson Ten

Tools and Equipment:

a. Hydraulic system with a defective pump or motor
b. Tools and gages

CLASSROOM HOURS

10

EVALUATION (THS-10)

Given a hydraulic system with a defective pump or motor and appropriate tools and gages, the student will troubleshoot and repair the defective component according to the instructor's specifications.

TASK

BP-01 Identifying pneumatic principles

PERFORMANCE OBJECTIVE

Identifying basic principles of pneumatics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Pneumatic power systems
  - 1. Pneumatic tools
  - 2. Linear motion devices
  - 3. Door openers
  - 4. Rotary motion devices
- b. Force, weight and mass
- c. Pressure
  - 1. Atmospheric
  - 2. Below atmospheric
  - 3. Pneumatic system pressure
- d. Work and energy
- e. Power
- f. Energy used in pneumatic systems
  - 1. Electrical
  - 2. Pneumatic
  - 3. Kinetic
  - 4. Potential
  - 5. Heat
- g. Diffusion and dispersion
- h. Separation of gases and liquids
- i. Compressibility
- j. Pneumatic laws
  - 1. Pascal's Law
  - 2. Boyle's Law
  - 3. Charles Law
  - 4. Ideal Gas Law
- k. Transmission of pneumatic fluid power
- l. Pneumatic leverage
- m. Air properties
- n. Air flow in pipes
- o. Viscosity of air
- p. Bernoulli's Principle
- q. Pneumatic power systems

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

- a. Plant Engineering Training Systems, Basic Pneumatics,
- b. Bobbs-Merrill, Fluid Power

CLASSROOM HOURS

5

EVALUATION (BP-01)

Given an overview of basic pneumatic power system principles, the student will correctly identify basic pneumatic principles and terminology.

TASK

BP-02 Identifying reciprocating compressors

PERFORMANCE OBJECTIVE

Identify and describe reciprocating compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor operation
b. Compressor classification
    1. Positive displacement
    2. Dynamic
c. Reciprocating piston compressors
d. Single and double-acting compressors
e. Compressor construction
f. Horse power cooling requirements
    1. Intercooling
    2. Aftercooler
    3. Water-cooled
    4. Counter-flow
    5. Parallel flow
g. Compressor lubrication
    1. Reduce friction
    2. Improve transfer of heat
    3. Splash or pressurized
h. Non-lubricated compressors
i. Compressor controls
    1. Unloading
    2. Holding type
    3. Suction unloader valves
    4. Centrifugal pressure release
    5. Electric or magnetic unloader

Provide Practical Application On:

Identify types of reciprocating compressors in the lab or in a plant.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Powers
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Two
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Several types of reciprocating compressors

CLASSROOM HOURS 5

EVALUATION (BP-02)

Given a reciprocating compressor, the student will accurately identify the type of compressor and describe it in terms of controls, lubrication requirements and application.

TASK

BP-03 Identifying rotary compressors

PERFORMANCE OBJECTIVE

Identify rotary compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor classification
b. Compressor selection
c. Compressor accessories

Provide Practical Application On:

Identify rotary compressor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Three
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Selection of several rotary compressors

CLASSROOM HOURS

5

EVALUATION (BP-03)

Given a rotary compressor, the student will accurately classify the compressor and describe its operation and application.

TASK

BP-04 Identifying primary air treatment in pneumatic systems

PERFORMANCE OBJECTIVE

Identify the method of primary air treatment in a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air treatment
b. Preliminary filtering
    1. Dry or wet filters
    2. Cleaning a filter
c. Relative humidity
    1. Temperature
    2. Weather
    3. Air pressure
d. Effects of moisture
e. Water removal
    1. Condensers after coolers
    2. Water and air cooled
f. Dew point
g. Moisture separators
    1. Gravity separation
    2. Drain plugs - safety
h. Oil scrubbers
    1. Operation
    2. Maintenance
i. Air Dryers
    1. Deliquescent
    2. Adsorption
j. Air receivers

Provide Practical Application On:

Identify methods of air treatment and in a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training System, Basic Pneumatics, Lesson Four
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Diagram of a pneumatic system

CLASSROOM HOURS 5

EVALUATION (BP-04)

Given a pneumatic system, the student will accurately identify and describe air treatment methods.

TASK

BP-05 Identifying secondary air treatment methods

PERFORMANCE OBJECTIVE

Identify methods of secondary air treatment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of treatment
b. Contaminant separation
c. Contaminant filtration
d. Filter classification and rating
e. Types of medium surface filters
f. Depth filters
g. Absorption filters
h. Lubricating

Provide Practical Application On:

Identify secondary air treatment methods used on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Five
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Diagram or live pneumatic system

CLASSROOM HOURS

5

EVALUATION (BP-05)

Given a pneumatic system, the student will accurately identify and describe secondary air treatment methods.

TASK

BP-06 Identifying piping, hoses and fittings used in pneumatic systems

PERFORMANCE OBJECTIVE

Identify the types of piping, hoses and fittings used in a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Piping requirements
  - 1. Pipe, tubing, hose and fitting combinations
  - 2. Free of leaks
- b. Air flow
  - 1. Streamlined
  - 2. Lominar flow
  - 3. Selection of pipe size
- c. Piping
  - 1. Black steel pipe
  - 2. Bursting pressure
  - 3. Safety factor
  - 4. Threading, welding and flonging
- d. Pipe applications
- e. Metallic tubing
- f. Tube bending
- g. Tube fittings
- g. Tube fittings
- h. Installation of tube
- i. Non-metallic tubing
- j. Hoses and fittings
- k. Hose installation

Provide Practical Application On:

Install pipes, tubes or hoses on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Pease, Basic Fluid Power
- b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

- a. Plant Engineering Training Systems, Basic Pneumatics Lesson Six
- b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

- a. Pipe
- b. Tube
- c. Hose
- d. Fittings and couplings
- e. Tools

CLASSROOM HOURS

10

EVALUATION (BP-06)

Given appropriate tools, supplies and equipment, the student will accurately use the correct procedure to install pipe, hoses and tubing on a pnuematic system.

TASK

BP-07 Identifying control valves

PERFORMANCE OBJECTIVE

Identify control valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Control valves
b. Manually operated valves
c. Automatically operated valves
d. Check valves
    1. Flapper
    2. Poppet
    3. Ball
    4. Cracking pressure
e. Self-activated shuttle valves
f. Control valves
    1. Spool
    2. Poppet
    3. Reciprocating disc
    4. Rotary
g. Three-way valves
h. Four-way valves
i. Five-way valves
j. Valve accessories

Provide Practical Application On:

Identify types of valves from diagrams or live examples.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Seven
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

Valves or diagrams of different types of valves

CLASSROOM HOURS

5

EVALUATION (BP-07)

Given a control valve or diagram, the student will correctly identify the valve and describe its purpose.

TASK

BP-08 Identifying pressure relief valves

PERFORMANCE OBJECTIVE

Identify pressure relief valves used in pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Controlling pressure
b. Safety valves
c. Relief valves
d. Refill valve construction
e. Pressure regulators
f. Regulator modifications
g. Safety

Provide Demonstration On:

Setting or adjusting a regulator

Provide Practical Application On:

Identifying, setting or adjusting a regulator

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Eight
b. Bobbs-Merrill, Fluid Power

CLASSROOM HOURS

5

EVALUATION (BP-08)

Given a pneumatic system with a pressure regulator, the student will correctly identify, set or adjust the valve according to the appropriate specifications.

TASK

BP-09 Identifying cylinders

PERFORMANCE OBJECTIVE

Identify cylinders used for pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pneumatic cylinders
b. Double-acting cylinders
c. Single-acting cylinders
d. Two-piston cylinders
e. Rod packings
f. Mounting
g. Selecting a cylinder
h. Cushioning
i. Piston rod strength

Provide Practical Application On:

Select a cylinder for a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Nine
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

a. Cylinders and specifications
b. Pneumatic system

CLASSROOM HOURS

3

EVALUATION (BP-09)

Given a pneumatic system and specifications, the student will correctly select the correct capacity cylinder for use with the system.

TASK

BP-10 Identifying motors

PERFORMANCE OBJECTIVE

Identify motors used on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pneumatic motors
b. Motor classification
    1. Piston motors
    2. Vane motors
    3. Positive displacement
c. Rating and selection factors
    1. Pressure rating
    2. Speed range
    3. Torque
    4. Horsepower
    5. Size, weight and mounting
d. Motor construction
e. Piston motors
f. Rotary activators
g. Portable air tools
1. Air boosters

Provide Practical Application On:

Select a motor and install it on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

a. Plant Engineering Training Systems, Basic Pneumatics, Lesson Ten
b. Bobbs-Merrill, Fluid Power

Tools and Equipment:

a. Motors
b. Pneumatic system
c. Tools

CLASSROOM HOURS

4

EVALUATION (BP-10)

Given a pneumatic system and specifications, the student will accurately select an appropriately rated motor and install the motor on the system.

TASK

PT-01 Identifying components of pneumatic systems

PERFORMANCE OBJECTIVE

Identify the components of a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The pneumatic system
    1. Components
    2. Power
b. The air supply system
c. Reciprocating compressors
    1. Single-acting
    2. Double-acting
    3. Multi-stage
    4. Piston displacement
d. Regulation and control
    1. Unloading mechanisms
    2. Suction valve-unloading
    3. Clearance pocket unloading
    4. Throtteling the intake
e. Rotary compressors
    1. Sliding vane
    2. Rotary screw
    3. Impeller
    4. Liquid ring
    5. Diaphragm
f. Cooling
    1. Intercooling
    2. After cooling
g. Compressor preventive maintenance
h. The delivered air system
    1. Filters/separators
    2. Absorption drying
i. Air line filters
j. Air line lubrication

Provide Practical Application On:

Identify components of a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson One

Tools and Equipment:

Diagram of a pneumatic system

CLASSROOM HOURS

5

EVALUATION (PT-01)

Given a diagram of a pneumatic system, the student will accurately identify the components and describe their functions.

TASK

PT-02 Reading pneumatic schematic diagrams.

PERFORMANCE OBJECTIVE

Read and interpret a pneumatic schematic diagram.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of symbols
   1. Pictorial
   2. Cutaway
   3. Schematic
b. Constructing symbols
   1. Basic symbols
   2. Functional symbols
   3. Complete, simplified and composite
c. Diagramming an air supply system
   1. A simple system
   2. Timing circuits
   3. Safety circuits
d. Symbols for special devices
e. Reading a system schematic

Provide Demonstration On:

Finding the direction of flow on a pneumatic diagram

Provide Practical Application On:

Read a pneumatic diagram and interpret it.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Two

Tools and Equipment:

Pneumatic schematic diagrams

CLASSROOM HOURS 5

EVALUATION (PT-02)

Given a schematic diagram of a pneumatic system, the student will accurately read the diagram and interpret all symbols including the direction of flow.

TASK

PT-03 Installing system components

PERFORMANCE OBJECTIVE

Install components on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor and auxiliaries
  1. Air intake failures
  2. Location of compressor
  3. Installation requirements
b. Compressor intakes
  1. Location
  2. Mounting
  3. Filter
c. Compressor foundations
d. After coolers
e. Receivers
f. Dryers
g. Pipe installation
  1. Pipe support
  2. Pipe threads
  3. Tubing
  4. Tube fittings
  5. Hose installation
h. Control systems
  1. Control valve installation
  2. Solenoid Coils
i. Cylinder installation
j. Safety

Provide Practical Application On:

Install a given component on a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

A/Vs:

Bobbs-Merrill, "Fluid Power"

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Three

Tools and Equipment:

a. Pneumatic components
b. Installation tools and supplies

CLASSROOM HOURS

5

EVALUATION (PT-03)

Given a component of a pneumatic system, the student will accurately install the component on the pneumatic system. Correct procedures and observing all safety recommendations must be adhered to by the student.

TASK

PT-04 Identifying procedures for pneumatic system maintenance

PERFORMANCE OBJECTIVE

Identify procedures for maintenance of a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Planning maintenance
  1. Lubrication
  2. Adjustment
  3. Preventive maintenance

b. Compressor room maintenance
  1. Compressor load
  2. Intake air filter
  3. Crank case oil level
  4. Belts or belt driven units

c. System maintenance
  1. Drains and moisture traps
  2. Filters and separations
  3. Air pressure
  4. Lubricators

d. Control system maintenance
  1. Shutting off the system for maintenance
  2. Regulators
  3. Cylinders

e. Tool maintenance
  1. Reasonable handling
  2. Lubrication

f. Keeping a maintenance log

Provide Demonstration On:

Developing a maintenance log

Provide Practical Application On:

Developing a maintenance log

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems Pneumatic Troubleshooting, Lessor Four

CLASSROOM HOURS 10

EVALUATION (PT-04)

Given a pneumatic system, the student will correctly identify procedures for maintaining the system and for setting up and keeping maintenance records.

TASK

PT-05 Determining system failures

PERFORMANCE OBJECTIVE

Determine the cause of failure in a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Understanding the system
b. Troubleshooting procedure
c. Locating troubles
d. Using the operations manual
e. Checking the air supply
f. Troubleshotting the actuator
g. Checking the control valve
h. Checking a control valve actuator
i. Checking sequence valves
j. Checking master control valve
k. Checking interlocks
l. Making final adjustments and operating the system

Provide Practical Application On:

Troubleshoot a pneumatic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Five

Tools and Equipment:

a. Schematic of system
b. Operations manual

CLASSROOM HOURS

10

EVALUATION (PT-05)

Given a defective pneumatic system, the student will accurately troubleshoot the system, correct the problem and operate the system to test for proper operation.

TASK

PT-06 Troubleshooting air compressors

PERFORMANCE OBJECTIVE

Troubleshoot air compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reciprocating compressor cooling
b. Compressor lubrication
c. Compressor valves
d. Crankcase ventilation
e. Piston rings and bearings
f. Control systems
g. Rotary compressors
h. Vane compressors
i. Rotary screw compressors
j. Centrifugal compressors

Provide Practical Application On:

Troubleshoot and repair a faulty compressor.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Six

CLASSROOM HOURS

10

EVALUATION (PT-06)

Given a faulty air compressor, the student will accurately troubleshoot the compressor and repair it to normal operation.

TASK

PT-07 Troubleshooting control valves

PERFORMANCE OBJECTIVE

Troubleshoot control valves on a pneumatic system and repair them.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Troubleshooting controls
   1. Non-starting
   2. Improper sequencing
   3. Miscellaneous equipment related problems
b. Troubleshooting a circuit that won't start
   1. Electric power
   2. Pneumatic power
   3. Manual overrides
   4. Sequence
   5. Lockouts
   6. Mechanical interference
   7. Solenoids
c. Checking manual overrides
d. Checking for lockouts
e. Checking circuit sequence
f. Checking for mechanical interference
g. Checking electrical solenoids
h. Troubleshooting improper sequence operation
i. Improper valve shifting
j. Changes in control timing
k. Miscellaneous problems
l. Lubrication problems

Provide Practical Application On:

Troubleshoot and repair a faulty control valve.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, 97224, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Seven

CLASSROOM HOURS 10

EVALUATION (PT-07)

Given a pneumatic system with a faulty control valve, the student will troubleshoot the valve and correct the problem according to the instructor's specifications.

TASK

PT-08 Troubleshooting cylinders

PERFORMANCE OBJECTIVE

Troubleshoot cylinders in a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cylinders
   1. Purpose
   2. Construction
   3. Pistons
   4. Piston rings, "O" rings
b. Cylinder troubleshooting and repair
   1. Checking cylinder size
   2. Proper air pressure
   3. Misalignment
   4. Worn packings and seals
   5. General installation
   6. Speed controls

Provide Practical Application On:

Troubleshoot and repair or replace a faulty cylinder.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Eight

CLASSROOM HOURS 5

EVALUATION (PT-06)

Given a pneumatic system with a faulty cylinder, the student will accurately troubleshoot and replace or repair the cylinder. The completed work must meet the instructor's specifications.

TASK

PT-09 Troubleshooting air motors

PERFORMANCE OBJECTIVE

Troubleshoot air motors on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Uses of air motors
b. Checking for sufficient air
c. Contaminated air
d. Lubrication
e. Air motor abuse
f. Hon and clamp maintenance
g. Air motor troubleshooting
h. Vane motors
i. Radial piston motor
j. Axial piston air motors
k. Percussion tools
l. Safety

Provide Practical Application On:

Troubleshoot a faulty air motor and repair it.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Maintenance Systems, Pneumatics Troubleshooting, Lesson Nine

CLASSROOM HOURS 10

EVALUATION (PT-09)

Given a faulty air motor, the student will accurately troubleshoot and repair the motor according to the instructor's specifications.

TASK

PT-10 Troubleshooting pneumatic hydraulic systems

PERFORMANCE OBJECTIVE

Troubleshoot a pneumatic and hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air oil tanks
b. Air hydraulic boosters
c. Pressure boosters
d. Single-pressure booster systems
e. Dual-pressure booster systems
f. Hydraulic control cylinders
g. Fast advance cylinders
h. Combined air loil cylinders
i. Pneumatic cushioning
j. Air hydraulic system interlock
k. Pneumatic service

Provide Practical Application On:

Troubleshoot and repair a pneumatic/hydraulic system.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pease, Basic Fluid Power
b. Stewart and Storer, Fluid Power

Student Manuals:

Plant Engineering Training Systems, Pneumatic Troubleshooting, Lesson Ten

CLASSROOM HOURS 6

EVALUATION (PT-10)

Given a defective system which is both pneumatically and hydraulically operated, the student will correctly identify the system, troubleshoot the problem and repair it according to the instructor's specifications.

TASK

IP-01 Identifying basic packaging methods

PERFORMANCE OBJECTIVE

Identify basic methods of packaging.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What is packaging?
   1. Packaging machinery
   2. Containers
b. Packaging operations
   1. Basic operating principles
   2. Skin packing
   3. Blister packing
   4. Shrink packing
c. Filling units
   1. Auger
   2. Weighing
   3. Volumetric and dump fillers
   4. Weighing units
   5. Liquid fillers
d. Maintenance of packaging machinery
e. Panned maintenance
   1. Chain drives
   2. Sprockets
   3. V-belts
   4. Cams
   5. Actuating devices
   6. Clutches
   7. Bearings
f. Lubrication

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction To Packaging, Lesson One

CLASSROOM HOURS 6

EVALUATION (IP-01)

Given specifications for a packaging operation, the student will identify the type and method of packaging and how to maintain the related machinery.

TASK

IP-02 Identifying actuating mechanisms

PERFORMANCE OBJECTIVE

Identifying actuating mechanisms.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of actuating mechanisms
   1. Levers
   2. Bell crank
b. Cranks
   1. Eccentric
   2. Oscillating motion
   3. Reciprocating motion
c. Cams
   1. Follower
   2. Edge
   3. Groove
   4. Barrell
   5. Face
d. Intermittent motion mechanisms
   1. Ratchet, single, double
   2. Partial gear
   3. Geneva wheel
   4. Indexing cam
e. Geneva sheels
f. Reciprocating drives
   1. Rack and pinion
   2. Stroke multiplier
   3. Continuous motion chain
g. Angle-doubling drives
h. Toggle links
i. Debents
   1. Fixed
   2. Adjustable
   3. Notched
   4. Positive
j. Overload protector devices

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Maintenance Systems, Introduction to Packaging, Lesson Two

CLASSROOM HOURS 18

EVALUATION (IP-02)

Given a packaging machine, the student will correctly identify actuating mechanisms and their applications.

TASK

IP-03 Identifying basic troubleshooting principles of packaging machinery

PERFORMANCE OBJECTIVE

Identify basic troubleshooting principles of packaging machinery.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of measurement
   1. Linear
   2. Rotary
   3. Lizuid
   4. Volumetric
   5. Weight
   6. Systems
   7. Time
b. Tolerances
c. Types of fits
   1.' Clearance fits
   2. Interferance fit
   3. Transition fit
d. Types of packaging machines
   1. Continuous motion
   2. Intermittent motion
e. Basic machine elements
   1. Timing
   2. Position
   3. Stroke
   4. Alignment
   5. Timing dial
f. Troubleshooting a packaging machine

Provide Demonstration On:

Troubleshooting a packing machine

Provide Practical Application On:

Troubleshoot a packing machine and repair it.

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Three

CLASSROOM HOURS

30

EVALUATION (IP-03)

Given a packaging machine with a defect, the student will accurately troubleshoot the machine and identify the procedure for correcting the problem.

TASK

IP-04 Identifying mechanical drives

PERFORMANCE OBJECTIVE

Identify mechanical drives.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drive mechanisms
   1. Types
   2. Maintenance
   3. Safety
b. Couplings
   1. Purpose
   2. Construction
   3. Types
c. Belt drives
   1. Types of belts
   2. Pulleys
d. Chain drives
   1. Chain construction
   2. Roller chains
   3. Chains used in packaging machines
e. Speed reducers
   1. Concentric
   2. Paralled shaft
   3. Right-angle shaft
   4. Shaft mounted
f. Gearing
   1. Open gearing
   2. Spur gears
   3. Double helical gears
   4. Herringbone
   5. Bevel
   6. Worm
   7. Rack and pinion

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lessor Four

CLASSROOM HOURS

6

EVALUATION (IP-04)

Given a packaging machine, the student will correctly identify the types of drive used and describe its operation

TASK

IP-05 Identifying motors and brakes

PERFORMANCE OBJECTIVE

Identify motors and brakes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Primary drive components
  - 1. Electric motor
  - 2. Pneumatic motor
  - 3. Hydraulic motor
  - 4. Purpose of brake or clutch
- b. A-C motors
  - 1. Induction
  - 2. Synchronous
- c. Fractional horsepower motors
  - 1. Two stator windings
  - 2. Split-phase motors
  - 3. Capacitor-start motor
- d. Three-phase motors
- e. Motor construction classification
  - 1. Open
  - 2. Totally closed
- f. Special motors
  - 1. Step motor
  - 2. Variable speed motor
  - 3. Rheostat
  - 4. Eddy-current drive
  - 5. Silicon controlled rectifier (SCR)
  - 6. Variable speed drive
- g. Mechanical/electrical speed drive
- h. Electric clutches
  - 1. Purpose
  - 2. Operation
- i. Hydraulic clutches
- j. Mechanical clutches
  - 1. Friction clutches
  - 2. Torque limiting clutch

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Five

Tools and Equipment:

Examples of various motors and brakes

CLASSROOM HOURS

36

EVALUATION (IP-05)

Given a packaging machine with a motor and brake application, the student will accurately identify the type of motor and brake, describe its operation and recommend appropriate maintenance procedures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

l. Friction shoe brakes
   1. Construction
   2. Operation
m. Friction disc brakes
   1. Construction
   2. Operation
r. Maintenance of motors and brakes

Provide Practical Application On:

Identify types of motors and brakes.

TASK

IP-06 Identifying electrical controls

PERFORMANCE OBJECTIVE

Identify electrical controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Type of machine band on electrical controls
    1. Run-on-demand
    2. Continuous run
    3. Intermittent motion
b. Startup sequence
c. Motor starters
    1. Manual type
    2. Electric type
    3. Thermal overload
d. Running sequence
e. Machine control
f. Time delay relays
    1. Pneumatic
    2. Electronic
g. Product control
    1. Solenoid operated valves
    2. Intake safety
    3. Loader safety
h. Adhesive application
    1. Intaglio gluing
    2. Spraying glue
    3. Hot melt glue
    4. Rotary cam operated switch
i. Product detectors
    1. Photoelectric
    2. Proximity
    3. Ultrasonic detector
j. Making wiring diagrams

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes Processes

Student Manuals:

Plant Engineering Maintenance Systems, Introduction to Packaging, Lesson Six

Tools and Equipment:

Wiring diagram

CLASSROOM HOURS 60

EVALUATION (IP-06)

Given a wiring diagram of a packaging operation, the student will correctly identify all electrical controls and describe their operation.

TASK

IP-07 Identifying packaging materials

PERFORMANCE OBJECTIVE

Identify packaging materials

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Materials
    1. Flexible films
    2. Rigid films
    3. Chipboard
    4. Cardboard
    5. Glass
    6. Plastics
    7. Metals
b. Films
    1.. Extrusion or casting
    2. Polyoleims
    3. Acrylics
    4. Vinyls
    5. Risers
    6. Grain, cross grain, fold
c. Shrink films
    1. Shrink tolerances
    2. Polyethylene
    3. Polypropylene
    4. Polyvinyl chloride
    5. Low-density, medium, high-density
d. Non-shrinkable films
e. Combination films
    1. Polycell
    2. Foil paper
    3. Structured films-supported
    4. Shrink films-non-supported
f. Water-soluble films
    1. Polyvinyl-alcohol (PVA)
    2. Applications
g. Plain and coated papers
h. Chipboard cartons

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Seven

CLASSROOM HOURS 6

EVALUATION (IP-07)

Given specifications for a material or substance to be packaged, the student will correctly identify an appropriate packaging material and describe its application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Glass bottles and jars
j. Plastic bottles and jars
    1. Manufacturing
    2. Applications

TASK

IP-08 Identifying methods of filling containers

PERFORMANCE OBJECTIVE

Identify methods used to fill containers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What is filling?
b. Flexible packaging
c. Vertical fill machines
d. Horizontal fill machines
e. Pouch filling
f. Weigh filling
g. Carton filling
k. Liquid filling
i. Filling by count

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Eight

CLASSROOM HOURS

6

EVALUATION (IP-08)

Given specifications for a product to be packaged, the student will correctly identify a method of filling which is appropriate and economical for that product.

TASK

IP-09 Identifying methods of sealing

PERFORMANCE OBJECTIVE

Identify methods used to seal packages and choose a method for a given application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What is sealing?
b. Tube sealing
c. Film sealing
d. High frequency sealing
e. Capping
f. Seaming
g. Tying
h. Sewing
i. Gluing
j. Stapling or stitching
k. Strapping

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Nine

CLASSROOM HOURS 6

EVALUATION (IP-09)

Given specifications for a packaging method, the student will accurately identify and describe the appropriate method of sealing the package.

TASK

IP-10 Identifying methods of weighing and measuring

PERFORMANCE OBJECTIVE

Identifying methods used to weigh and measure.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Units of weight
    1. English
    2. Metric
b. Measuring devices on packaging machines
    1. By volume
    2. By weight
    3. Net or gross weight
    4. Check weighing
c. Volumetric measuring
    1. Presized containers
    2. Positive displacement pumps
    3. Quantity or part counting
d. Weighing devices
    1. Patter or weighing platform
    2. Lever system
    3. Damper
    4. Transducer
    5. Lever-position sensing device
    6. Electronic controls
e. Scale components and installation
    1. The "seal"
    2. Spring
    3. Clamping device
    4. Transducer
    5. Calibration
f. Net weighers
g. Controls
h. Check weighers
i. Troubleshooting and maintenance
j. Installation

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Introduction to Packaging, Lesson Ten

CLASSROOM HOURS 18

EVALUATION (IP-10)

Given a weighing or measuring device on a packaging machine, the student will accurately calibrate the machine to weigh or measure the appropriate quatity of a product and operate the machine to correctly fill the container.

INSTRUCTIONAL ACTIVITIES

Provide Demonstration On:	Provide Practical Application On:
Calibrating a weighing or measuring device	Calibrate a weighing or measuring device.

TASK

PM-01 Identifying methods of gravity and vacuum filling

PERFORMANCE OBJECTIVE

Identify methods of gravity and vacuum filling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Gravity filling
b. Vacuum pumps
c. Vane pumps construction
d. Piston pump construction
e. Vacuum pump installation
f. Vacuum filling
g. Gravity/vacuum filling
h. Balanced vacuum filling
i. Submerged vacuum filling
j. Fill height control
k. Container control

Provide Demonstration On:

Installing a vacuum pump

Provide Practical Applications On:

Install a vacuum pump.

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Packaging Machinery, Lesson One

CLASSROOM HOURS 18

EVALUATION (PM-01)

Given specifications for a filling methods using gravity or vacuum, the student will correctly describe its operation.

TASK

PM-02 Identifying procedures for bottle filling and capping

PERFORMANCE OBJECTIVE

Identify procedures and methods for bottle filling and capping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bottle filling consideration
b. Volumetric filling
c. Piston type filling machines
d. Piston type volumetric filling machines
e. Auger feed pumps
f. Volumetric-displacement machines
g. Constant-level filling machines
h. Other constant level fillers
i. Counter pressure filling
j. Capping and sealing
k. Screw cappers
l. Bottle filling machine maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training System, Packaging Machinery, Lesson Two

CLASSROOM HOURS 18

EVALUATION (PM-02)

Given a bottle filling and capping machine, the student will accurately identify and describe the type of machine and make all adjustments necessary for proper operation.

TASK

PM-03 Identifying methods for pressure liquid filling

PERFORMANCE OBJECTIVE

Identify methods for pressure liquid filling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic pressure filling principles
b. Pressure filling techniques
c. Construction
d. Indexing pressure fillers
e. Indexing container filling
f. Machine control
g. Indexing container control
h. Continuous motion pressure fillers
i. Rotary pressure fillers
j. Continuous container control
k. Continuous container filling
l. Filling nozzle construction
m. Direct pressure filling machines
n. Filling control

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Packaging Machinery, Lesson Three

CLASSROOM HOURS 24

EVALUATION (PM-03)

Given a bottling and capping machine which uses pressure liquid filling, the student will correctly identify the method of filling used and make all necessary adjustments for operation of the machine.

TASK

PM-04 Identifying aeorosol fillers

PERFORMANCE OBJECTIVE

Identify aerosol fillers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Aerosol filling
b. Aerosol containers
c. Metal containers
d. Aerosol valves
e. Aerosol propellants
f. Container filling
g. Cold filling
h. Pressure filling
i. Individual station operation
j. Safety testing
k. Drying
l. Capping
m. Additional accessory equipment

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Packaging Machinery, Lesson Four

CLASSROOM HOURS 30

EVALUATION (PM-04)

Given an aerosol filling operation, the student will correctly identify all the steps in the operation and describe the procedure for each step.

TASK

PM-05 Identifying methods of bag forming and filling

PERFORMANCE OBJECTIVE

Identify methods of bag forming and filling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Machine classification
b. Bag materials
c. Bag construction
d. Classifying bags
e. Bag forming
f. Special bag forming operations
g. Film extrusion
h. Bag filling machines
i. Filling machine modification
j. Bag machinery maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Packaging Machinery, Lesson Five

CLASSROOM HOURS 12

EVALUATION (PM-05)

Given a bagging machine, the student will make all adjustments and perform all necessary maintenance functions for proper operation.

TASK

PM-06 Identifying methods of pouch filling

PERFORMANCE OBJECTIVE

Identify methods of pouch filling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pouch filling
b. Pouch materials and control
c. Vertical filling machines
d. Vertical pouch filling
e. Horizontal pouch filling
f. Continuous

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
Kazanas, Manufacturing Processes	Plant Engineering Training Systems, Packaging Machinery, Lesson Six

CLASSROOM HOURS 12

EVALUATION (PM-06)

Given a pouch filling operation, the student will correctly identify the method used, the type of machine and its operation.

TASK

PM-07 Identifying volumetric filling machines

PERFORMANCE OBJECTIVE

Identify volumetric filling machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of volumetric filling machines
b. Liquid volumetric filling
c. Volumetric piston filling
d. Volumetric filling machine maintenance

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
Kazanas, Manufacturing Processes	Plant Engineering Training Systems, Packaging Machinery, Lesson Seven

CLASSROOM HOURS 18

EVALUATION (PM-07)

Given a volumetric filling machine, the student will correctly identify the type of machine, describe its process and adjust and maintain the machine for proper operation.

TASK

PM-08 Identifying filling by count machines

PERFORMANCE OBJECTIVE

Identify machines which fill containers by count.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of count filling
b. Machine selection factors
c. Filling by count machines
d. Strip packaging machines
e. Cottoning devices

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
Kazanas, Manufacturing Processes	Plant Engineering Training Systems, Packaging Machinery, Lesson Eight

CLASSROOM HOURS

12

EVALUATION (PM-08)

Given a packaging machine which fills by count, the student will identify the type of machine and describe its operation.

TASK

PM-09 Identifying methods of positive displacement filling

PERFORMANCE OBJECTIVE

Identify methods of positive displacement filling and be able to adjust and maintain related machinery.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Principles of filling
b. Controlling the fill
c. Filling machines
d. Manual fillers
e. Automatic filling machines
f. Timing control sequence
g. Continuous motion filling machines
h. Rotary filling methods
i. Machine maintenance

INSTRUCTIONAL MATERIALS

Textbooks:	Student Manuals:
Kazanas, Manufacturing Processes	Plant Engineering Training Systems, Packaging Machinery, Lesson Nine

CLASSROOM HOURS	18

EVALUATION (PM-09)

Given a positive displacement type filling machine, the student will correctly identify the type of machine, describe its operation and perform all adjustments and maintenance for proper operation.

TASK

PM-10 Identifying methods of blister packing

PERFORMANCE OBJECTIVE

Identify methods of blister packing a product and describe the operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Blister packaging
b. Blister films
c. Blister cards
d. Blister cardboard construction
e. Blister card problems
f. Reducing blister failures
g. Blister forming machines

INSTRUCTIONAL MATERIALS

Textbooks:

Kazanas, Manufacturing Processes

Student Manuals:

Plant Engineering Training Systems, Packaging Machinery Lesson Ten

CLASSROOM HOURS

30

EVALUATION (PM-10)

Given a blister packing machine, the student will accurately identify the type of machine and describe its operation.

TASK

CM-01 Identifying procedures for uncasing and unscrambling

PERFORMANCE OBJECTIVE

Identify procedure for uncasing and unscrambling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How containers are received
   1. Types of containers
   2. Sealing
   3. Pallets
   4. Uncasing and unscrambling
b. Manual uncasing
c. Low-volume uncasing
   1. Rotary unscrambling machine
   2. Application
   3. Low volume unscrambling
d. Unscrambling with wire-mesh conveyors
e. Unscrambling with parallel conveyors
f. Automatic uncasing
g. Combined automatic operations
h. Unscrambling plastic bottles
i. Unscrambling with an inclined hopper
j. Conveyor chain and its care
   1. Types of chains
   2. Maintenance

Provide Demonstration On:

Maintaining a conveyor chain

Provide Practical Application On:

Maintain a conveyor chain.

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson One

CLASSROOM HOURS 10

EVALUATION (CM-01)

Given casing machinery, the student will correctly identify procedures for uncasing and unscrambling containers. Students must also maintain a conveyor chain according to the instructor's requirements.

TASK

CM-02 Identifying procedures for cleaning and washing containers

PERFORMANCE OBJECTIVE

Identify procedures for cleaning and washing containers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Necessity for clean containers
b. Container cleaning methods
  1. Air cleaning
  2. Pressurized liquid spray
c. Semi-automatic air cleaning
d. Fully-automatic air cleaning
e. Inverter air cleaners
f. Manual washing with water
g. Combination bottle washer
h. Metal washers
i. High production washing
j. Container warming
k. Pasteurization
k. Pasteurization
  1. Purpose
  2. Procedure
  3. Pasteurizers
l. Lubricating a pasteurizer
  1. Chain
  2. Shaft and take-up bearings
  3. Drive gears
  4. Speed reducer drive
  5. Center support rollers
  6. Motors
  7. Drive mechanisms
m. Pasteurizer maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Two

CLASSROOM HOURS 10

EVALUATION (CM-02)

Given containers which need washing and cleaning, the student will identify and describe machinery and procedures used to clean and wash the containers. The student will correctly lubricate a pasteurizer.

TASK

CM-03 Identifying gathering machines

PERFORMANCE OBJECTIVE

Identify gathering machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of gathering machines
   1. Multi-packers
   2. Case packers
   3. Bundlers
b. Multipacking machines
c. In-feed supply machinery for multipacking
d. Continuous run multipacking
   1. Transfer mechanism
   2. Accumulating device
e. Skip-carton detector
f. Continuous run accumulator
g. Shacking sequence for continuous run
h. Cycle-style multipacking
i. Cycling operations
   1. Wrapping machine
   2. Tumble box
j. Case packing machines
   1. Gathering
   2. Casing
   3. Horizontal loading
   4. Vertical loading
   5. End loading
   6. Closing the cases
k. Bundling machines
l. Gathering machine maintenance
   1. Lubrication
   2. Adjustment

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Three

CLASSROOM HOURS 20

EVALUATION (CM-03)

Given a gathering machine, the student will adjust and lubricate the machine following correct procedures.

TASK

CM-04 Identifying cartoning machines

PERFORMANCE OBJECTIVE

Identify cartoning machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cartons and their applications
    1. Purpose of cartons
    2. Machinery for cartoning
b. Steps in carton making
    1. Blanks
    2. Tray-style cartons
    3. Printing
    4. Die-cutting
    5. Gluing
c. Common types of cartons
    1. Reverse tuck
    2. Straight tuck
    3. Tubular cartons
    4. Arthur Lock
    5. Automatic bottom
    6.
    6. Crash fold
    7. Cells
d. Glue-end cartons
    1. Applications
    2. Full flaps, economy flaps and butt flaps
e. Types of cartoning machines
    1. Semi-automatic
    2. Automatic cartoner
    3. Intermittent
    4. Continuous
f. Methods of carton feeding
    1. Stripping feed
    2. Expanding draw feed
    3. Rotary feed
g. Product in feed
h. Horizontal carton loading

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Four

CLASSROOM HOURS 20

EVALUATION (CM-04)

Given a cartoning machine, the student will correctly adjust the machine and perform all regular maintenance operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Cartoning machine attachments
    1. Printing/coding mechanisms
    2. Leaflet feeding mechanism
j. Closing cartons
k. Gluing cartons
l. Carton machine maintenance

TASK

CM-05 Identifying casing machines

PERFORMANCE OBJECTIVE

Identify casing machines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Casing machine types
   1. Using previously used cans
   2. New cans fed from a can former
b. Can forming machines
   1. Operating principles
   2. End-opening can former and sealer
   3. Top-opening
c. Horizontal casing machines
   1. Applications
   2. Operating principle
d. Vertical casing machines
e. Top filling machines
f. Side-filling machines
g. Bottom filling machines
h. Case taping machines
i. Casing long narrow products
j. Heat shrink sealing
k. Casing machine maintenance
   1. Adjustments
   2. Electrical detection devices
   3. Controls

Provide Demonstration On:

Adjusting a casing machine

Provide Practical Application On:

Adjust a casing machine

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manual:

Plant Engineering Training Systems, Casing Machinery, Lesson Five

CLASSROOM HOURS 20

EVALUATION (CM-05)

Given a casing machine, the student will correctly identify the type of machine and its applications and make all adjustments necessary for proper operation.

TASK

CM-06 Identifying wrapping machines

PERFORMANCE OBJECTIVE

Identify wrapping machine.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wrapping machines
    1. Description
    2. Purpose

b. Machine drive

c. Wrapping materials
    1. 20 pound to 60 pound kraft paper
    2. Waxed paper
    3. Cellophane

d. Change parts
    1. Paper cut-off change gears
    2. Tuckers and pusher plate
    3. Feed conveyor top plate
    4. Elavator head
    5. Paper reel
    6. Folders

e. Scale and dial settings and controls
    1. Main hand wheel
    2. Starting clutch handle
    3. Output speed change hand wheel
    4. Paper stop scales
    5. Paper feed belt scale
    6. Paper knife dial
    7. Light source and photo cell hand wheel
    8. Transport chain scale
    9. Heater and discharge scale

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Six

CLASSROOM HOURS 20

EVALUATION (CM-06)

Given specifications for a packaging job, the student will correctly identify the type of machine and the method of packaging used.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    10. Standard heater thermostat
    11. Folder and bottom plate thermostat
f. Paper feed
g. Adjusting the paper feed
h. Adjusting the paper reel
i. Paper corrugating wires
j. Paper rollers
k. Paper cut-off change gears
l. Paper cut-off knife
m. Paper stops and guides
n. Paper feed belts
o. Starting the machine
p. Machine adjustments
    1. Slide guides
    2. Automatic paper control
    3. Package elavator
    4. Bottom folder
q. Heat controls
r. Glues
s. Package discharge
t. Lubrication
    1. SAE 30 oil
    2. No grease

TASK

CM-07 Strapping and stitching packages

PERFORMANCE OBJECTIVE

Strap or stitch a package.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Strapping materials
    1. Metallic
    2. Non-metallic
    3. Plastics, nylon and polypropylene
    4. Devices for applying metallic strapping
b. Tensioners and sealers
    1. Bar type
    2. Steel joints
    3. Friction joint
    4. Rotary tension wheel or clog
c. Combination tools
    1. Combined tensioner and pealer
    2. Manually powered
    3. Air powered
d. Combination tool maintenance
e. Strapping machines
f. Operation of a strapping head
    1. Feeding
    2. Tensioning
    3. Sealing
    4. Shearing
    5. Strapping head maintenance
g. Strapping systems
h. Stitching machines
    1. Stitcher functions
    2. Operation
    3. Defects in stitches
    4. Adjusting defective stitching machines

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Seven

CLASSROOM HOURS

30

EVALUATION (CM-07)

a. Given a package and appropriate equipment and supplies, the student will properly apply strapping to the package.

b. Given a stitcher and a package, the student will adjust the stitcher for proper operation and stitch the package correctly.

TASK

CM-08 Identifying adhesives and their applications

PERFORMANCE OBJECTIVE

Identify adhesives and their applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Adhesives used in packaging
    1. Applications
    2. Sealing factors
b. Properties of adhesives
    1. Penetration
    2. Solids content
    3. Solubility
    4. Tackiness
    5. Viscosity
c. Types of adhesives
    1. Hot melts
    2. Advantages of hot melts
    3. Hot melt systems
    4. Hot melt troubleshooting
    5. Maintaining hot melt equipment
    6. Cleaning hot melt equipment
d. Synthetic adhesives other than hot melt
    1. Resin emulsions
    2. Borax
    3. Latex
e. Natural adhesives
    1. Starch-based adhesives
    2. Protein-based adhesives
f. Applying natural adhesives
g. Maintaining application equipment
h. Storing and handling adhesives

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Eight

CLASSROOM HOURS 20

EVALUATION (CM-08)

Given adhesive equipment and adhesive, the student will correctly identify the type of adhesive and equipment used, describe its applications and maintain and adjust the equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

1. Temperature
2. Covered containers
3. Thinning an adhesive
4. Thinning cold adhesives
5. Changing adhesives
6. Aging of adhesives

TASK

CM-09 Identifying procedures for labeling and coding

PERFORMANCE OBJECTIVE

Identify procedures for labeling and coding packaging machinery.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of labeling
b. Label forms
    1. Pre-cut
    2. Rolls
    3. Pressure-sensitive
c. Manual labeling
d. Semi-automatic labeling
e. Automatic labeling
f. Continuous roll feeding
g. Indirect label feeding
h. Pressure sensitive labeling
    1. Operation
    2. Application methods
i. Labeling head set up and maintenance
j. Automatic pressure sensitive labeling
k. Daily and monthly maintenance
l. Cooling attachments
    1. Revolving cylinder
    2. Steel roller coder
m. Bottom coding of containers
n. Flexographic imprinting

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Nine

CLASSROOM HOURS 22

EVALUATION (CM-09)

Given packaging which requires labeling, the student will accurately identify the type of machine used and the proper method of labeling. The student will maintain the machine and adjust it for operation.

TASK

CM-10 Identifying procedures for maintenance and safety of casing machinery

PERFORMANCE OBJECTIVE

Identify procedures for maintenance and safety of casing machinery.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Planned maintenance (PM)
b. Spare parts
c. Lubrication schedules
d. Mechanical maintenance
    1. Tension and alignment of drive belts
    2. Chain drives
    3. Conveyors
    4. Gear drives
e. Electrical Maintenance
    1. Motor
    2. Safety
    3. Solenoids
    4. Electric heaters
    5. Transformers
    6. Limit switches
f. Fluid components maintenance
    1. Filters
    2. Pressure regulators
    3. Air compressors
    4. Hydraulic pumps
    5. Cylinders
g. Maintenance safety
h. Safe clothing
i. Using tools correctly
j. Hand tool safety
k. Machine guards
l. Material handling

INSTRUCTIONAL MATERIALS

Textbooks:

New Jersey Vocational-Technical Curriculum Laboratory, Package Line Mechanics

Student Manuals:

Plant Engineering Training Systems, Casing Machinery, Lesson Ten

CLASSROOM HOURS

20

EVALUATION (CM-10)

Given machinery for a casing operation, the student will correctly identify appropriate procedures for maintaining the equipment, including lubrication, mechanical and electrical maintenance.

SECTION VI

REFERENCES, RESOURCES

RESOURCES

Instructional Resource Matrix

The Instructional Resource Matrix lists the instructional resources required to carry out the learning activities in each unit in the program. The resources are divided into the categories of audio visuals, textbooks and student materials.

Audio visuals are identified by the following symbols: slide/tapes (ST) and filmstrips (FS).

Textbooks are identified by the author(s) and title.

Student Materials are identified by the supplier and title.

Textbook List

This list identifies the textbooks referenced in the Unit Guide section and on the Instructional Resource Matrix.

Audio Visuals

The suppliers of the audio visuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Student Materials

The suppliers of the student manuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Additional Instructional Resources

This section lists instructional resources which may be used in addition to those primary resources listed on the Unit Guides. The resources are divided into the categories of textbooks and audio visuals.

Resource Addresses

Addresses of instructional materials referenced on the Unit Guides and in the Additional Instructional Resources section are given.

CURRICULUM AREA: Electro-Mechanical Technology

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
BBR-01 Identifying basic principles of blueprint reading	Career Aids, Inc.: "Drafting and Blueprint Reading Series" (TR/T)	Willis; Jensen and Hines	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson One
BBR-02 Identifying elements of machine drawings	"	"	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Two
BBR-03 Identifying hydraulic and pneumatic drawings	-	Pease	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Three
BBR-04 Using machine drawings in the maintenance of machinery and equipment	Career Aids, Inc.: "Drafting and Blueprint Reading Series" (TR/T)	Willis; Jensen and Hines	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Four
BBR-05 Reading building drawings	"	"	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Five
BBR-06 Reading electrical drawings	"	"	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Six
BBR-07 Reading pipe system drawings	-	Pease	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Seven
BBR-08 Reading sheet metal drawings	Career Aids, Inc.: "Sheet Metal Work Explained" (FS)	Feirer; Walker	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Eight
BBR-09 Using shop math to interpret blueprints	-	Delmar: Mathematics for the Shop; Hobar: Practical Problems in Math Series	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Nine

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
BBR-10 Sketching schematic diagrams	Career Aids, Inc.; "Drafting and Blueprint Reading Series" (TR/T)	Willis; Jensen and Hines	Plant Engineering Training Systems: Basic Blueprint Reading, Lesson Ten
RSS-01 Identifying types of schematics used in plant engineering	Career Aids, Inc.: "Basic Electricity and Electronics Explained" (FS)	Morrow; Smith; AAVIM	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson One
RSS-02 Identifying the symbols on electrical, piping and fluid power diagrams	"	Morrow; Bobbs-Merrill: Industrial Electronic Systems; Howard W. Sams Co., Inc.: Collected Basic Circuits	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Two
RSS-03 Identifying guidelines for reading schematics	-	Smith; Morrow	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Three
RSS-04 Identifying electrical symbols	-	Loper and Ahr; Delmar: EMT Series: Electronics/Electricity; Howard W. Sams, Co., Inc.: How to Read a Schematic Diagram	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Four

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RSS-05 Reading electrical diagrams	"	Howard W. Sams Co., Inc.: How to Read a Schematic Diagram	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Five
RSS-06 Identifying piping symbols	Career Aids, Inc.: "Drafting and Blueprint Reading" (TR/T)	Morrow; Willis	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Six
RSS-07 Reading piping schematics	-	Willis	Oregon ILS: IM-HY-03; Oregon ILS: IM-HY-04; Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Seven
RSS-08 Identifying fluid power symbols	Howard W. Sams and Co., Inc.: "Fluid Power" (TR)	Pease; Stewart and Storer	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Eight
RSS-09 Reading fluid power schematics	-	"	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Nine
RSS-10 Identifying welding symbols	Hobar: "Blueprint Reading for Welders" (TR)	Griffin and Roden	Plant Engineering Training Systems: Reading Schematics and Symbols, Lesson Ten
MM-01 Identifying the physical structure of metals	-	Feirer; Johnson	Plant Engineering Training Systems: Metal Materials, Lesson One
MM-02 Identifying properties of metals	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Two
MM-03 Identifying methods of heat treatment	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Three

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
MM-04	Identifying metal manufacturing processes	Career Aids, Inc.: "Foundry Work" (FS)	Feirer; Johnson	Plant Engineering Training Systems: Metal Materials, Lesson Four
MM-05	Identifying iron manufacturing processes	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Five
MM-06	Identifying processes used to produce steel	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Six
MM-07	Identifying processes used to produce aluminum	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Seven
MM-08	Identifying processes for the production of magnesium and titanium	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Eight
MM-09	Identifying processes used to produce copper	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Nine
MM-10	Identifying processes used to produce lead, nickel, tin and zinc	-	"	Plant Engineering Training Systems: Metal Materials, Lesson Ten
NMM-01	Identifying non-metal materials	-	Olivio and Olivio	Plant Engineering Training Systems: Non-Metal Materials, Lesson One
NMM-02	Identifying properties of plastics	Howard W. Sams, Co., Inc.: "Foam Molding"(ST) "Injection Molding"(ST); "Polymer Structure"(ST); "Reinforced Plastics" (ST); "Rotational Molding" (ST); "Thermoforming" (ST)	Schmidt; Richardson	Plant Engineering Training Systems: Non-Metal Materials, Lesson Two
NMM-03	Identifying properties of rubber	-	Smith, Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Three

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
NMM-04	Identifying properties and applications of carbon	-	Smith, Materials of Construction	Plant Engineering Training Systems: Non-Metal Materials, Lesson Four
NMM-05	Identifying industrial chemicals and their applications	-	Smith	Plant Engineering Training Systems: Non-Metal Materials, Lesson Five
NMM-06	Identifying paint, coatings and their applications	-	"	Plant Engineering Training Systems: Non-Metal Materials, Lesson Six
NMM-07	Identifying insulating materials and their applications	-	"	Plant Engineering Training Systems: Non-Metal Materials, Lesson Seven
NMM-08	Identifying properties and applications of construction materials	DCA: "Brick and Stone Masonry" (TR)	Dezettel; Smith	Plant Engineering Training Systems: Non-Metal Materials, Lesson Eight
NMM-09	Identifying properties and application of wood	Hobar: "Wood Technology" (TR)	Smith	Plant Engineering Training Systems: Non-Metal Materials, Lesson Nine
NMM-10	Identifying adhesives and tapes	-	"	Plant Engineering Training Systems: Non-Metal Materials, Lesson Ten
T-01	Identifying and using measuring tools	Hobar: "Micrometers, Calipers and Gages" (TR); Hobar: "Reading the Micrometer" (ST); DCA: "Precision Measurement" (TR)	Dover Publishing: Tools and Their Uses; Hinrichs	Plant Engineering Training Systems: Hand Tools, Lesson One
T-02	Identifying and using wrenches and screwdrivers	Hobar: "Screwdrivers" (TR); DCA: "Screwdrivers" (TR)	Dover: Tools and Their Uses; Hobar: Screwdrivers	Plant Engineering Training Systems: Hand Tools, Lesson Two
T-03	Identifying and using pipefitting tools	Hobar: "Laboratory Exercise in Pipefitting" (ST)	Dover: Tools and Their Uses	Plant Engineering Training Systems: Hand Tools, Lesson Three

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
T-04	Identifying and using plumbing tools	-	Dover: Tools and Their Uses; Audel: Plumbers and Pipefitters Library	Plant Engineering Training Systems: Hand Tools, Lesson Four; Midamerica Vocational Curriculum Consortium: Residential Plumbing Tools and Equipment
T-05	Identifying and using electrical tools	Hobar: "Housewiring" (FS)	AAVIM	Plant Engineering Training Systems: Hand Tools, Lesson Five
T-06	Identifying and using cement plaster and glazing tools	Hobar: "MTR-II" (TR); "MTR-III" (TR); "MTR-IV" (TR); "MTR-V" (TR); "MTR-VII" (TR)	White; Moore; Smith; NAVTRA; Prentice-Hall: Masonry and Concrete	Plant Engineering Training Systems: Hand Tools, Lesson Six
T-07	Identifying and using woodworking tools	Prentice-Hall: "XF-1121"; "XF-1120" (CFS); Hobar: "Hammers, Nails and Nailing Technique" (ST); Hobar: WHT-1 through WHT-22 (TR); Bergwall: "Woodworking Handtools Explained" (FS)	Reed; NAVTRA; Dover	Plant Engineering Training Systems: Handtools, Lesson Seven
T-08	Identifying and using sheet metal tools	Hobar: "Sheet Metal Hand Tools" (TR); Bergwall: "Sheet Metal Work" (FS)	Ludwig; Walker	Plant Engineering Training Systems: Handtools, Lesson Eight
T-09	Identifying and using metal working tools	-	"	Plant Engineering Training Systems: Handtools, Lesson Nine
T-10	Identifying and using hoisting and pulling tools	-	Morrow	Plant Engineering Training Systems: Handtools, Lesson Ten

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
SP-01	Identifying plant safety procedures	AAVIM: "Developing Shop Safety Skills" (ST); Career Aids, Inc.: "Safetitudes" (FS); Career Aids, Inc.: "General Shop Safety" (FS)	AAVIM	Plant Engineering Training Systems: Plant Safety, Lesson One; AAVIM: Developing Shop Safety Skills
SP-02	Identifying work area safety precautions	Career Aids, Inc.: "Safety at Work" (FS)	-	Plant Engineering Training Systems: Plant Safety, Lesson Two
SP-03	Observing safety in handling materials	Career Aids, Inc.: "Lift with Your Head" (FS)	-	Plant Engineering Training Systems: Plant Safety, Lesson Three
SP-04	Observing safety precautions for tools and equipment	Hobar: SMP-II; SMP-III; SMP-IV (TR); Hobar: "Power Tool Safety and Operation" (TR); Career Aids, Inc.: "Using Hand Tools," Parts 1 and 2 (TR); Career Aids, Inc.: "Using Power Tools" (TR)	-	Plant Engineering Training Systems: Plant Safety, Lesson Four; Hobar: Power Tools Safety and Operation
SP-05	Identifying machinery safeguards	Hobar: "Power Tool Safety and Operation" (TR)	-	Plant Engineering Training Systems: Plant Safety, Lesson Five; Hobar: Power Tool Safety and Operation
SP-06	Identifying personal protection gear	University of Missouri: "Safety in Trade and Industrial Education" (ST)	University of Missouri, Safety in Trade and Industrial Education	Plant Engineering Training Systems: Plant Safety, Lesson Six

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
SP-07 Observing electrical safety precautions	Career Aids, Inc.: "Electrical Safety in the Shop" (FS); Career Aids, Inc.: "Electricity/Electronics" (FS)	-	Plant Engineering Training Systems: Plant Safety, Lesson Seven
SP-08 Handling hazardous materials	Career Aids, Inc.: "Safety at Work" (FS)	McGraw-Hill: Occupational Safety and Health Management	Plant Engineering Training Systems: Plant Safety, Lesson Eight
SP-09 Identifying fire prevention procedures	Career Aids, Inc.: "School Shop Safety" (FS)	Colburn	Plant Engineering Training Systems: Plant Safety, Lesson Nine
EM-01 Identifying the nature of force	-	Olivio and Olivio	Plant Engineering Training Systems: Elements of Mechanics, Lesson One
EM-02 Identifying physical properties of motion	-	"	Plant Engineering Training Systems: Elements of Mechanics, Lesson Two
EM-03 Identifying principles of work and energy	-	"	Plant Engineering Training Systems: Elements of Mechanics, Lesson Three
EM-04 Identifying principles of simple machines	-	"	Plant Engineering Training Systems: Elements of Mechanics, Lesson Four
EM-05 Identifying practical applications of power	-	-	Plant Engineering Training Systems: Elements of Mechanics, Lesson Five
EM-06 Calculating area and volume	-	Olivio and Olivio	Plant Engineering Training Systems: Elements of Mechanics, Lesson Six

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
EM-07	Identifying and using handtools	Hobar: "Hammer, Nails, and Nailing Technique" (ST); "Screws and Driving Tools" (ST); "Hand Tools" Series One (ST)	Dover: Tools and Their Uses	Plant Engineering Training Systems: Elements of Mechanics, Lesson Seven
EM-08	Identifying and using power tools	Hobar: "Using Portable Power Tools" (FS); "Drill Press and Controls" (FS); "Tool Grinder" (Series) (FS)	"	Plant Engineering Training Systems: Elements of Mechanics, Lesson Eight
EM-09	Identifying types of fasteners		Hobar: Tools and Their Uses	Plant Engineering Training Systems: Elements of Mechanics, Lesson Nine
EM-10	Identifying properties of frictions		Olivio and Olivio	Plant Engineering Training Systems: Elements of Mechanics, Lesson Ten
L-01	Identifying basic principles of lubrication	DCA: "Lubricants" (ST)	McGraw-Hill: Standard Handbook of Lubrication Engineering	Plant Engineering Training Systems: Lubrication, Lesson One
L-02	Identifying characteristics of lubricants	-	"	Plant Engineering Training Systems: Lubrication, Lesson Two
L-03	Identifying additives, lubricating action and bearing lubrication	-	"	Plant Engineering Training Systems: Lubrication, Lesson Three
L-04	Identifying oils and their applications	-	"	Plant Engineering Training Systems: Lubrication, Lesson Four

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
L-05 Identifying general purpose greases	-	Lubrication Handbook	Plant Engineering Training Systems: Lubrication, Lesson Five
L-06 Identifying special purpose greases	-	"	Plant Engineering Training Systems: Lubrication, Lesson Six
L-07 Identifying lubricating compounds	-	"	Plant Engineering Training Systems: Lubrication, Lesson Seven
L-08 Identifying lubrication systems and methods	-	-	Plant Engineering Training Systems: Lubrication, Lesson Eight
L-09 Identifying automatic lubrication methods	-	-	Plant Engineering Training Systems: Lubrication, Lesson Nine
L-10 Identifying methods of lubricant storage and handling	-	Lubrication Handbook	Plant Engineering Training Systems: Lubrication, Lesson Ten
DS-01 Identifying common couplings	-	Delmar: EMT Series Drives	Plant Engineering Training Systems: Drive Components, Lesson One
DS-02 Identifying special couplings	-	"	Plant Engineering Training Systems: Drive Components, Lesson Two
DS-03 Identifying clutches	-	"	Plant Engineering Training Systems: Drive Components, Lesson Three
DS-04 Identifying V-belt drives	-	"	Plant Engineering Training Systems: Drive Components, Lesson Four
DS-05 Identifying chain drives	-	"	Plant Engineering Training Systems: Drive Components, Lesson Five
DS-06 Identifying speed reducers	-	"	Plant Engineering Training Systems: Drive Components, Lessons Six and Seven

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
DS-07 Identifying gears	-	"	Plant Engineering Training Systems: Drive Components, Lesson Eight
DS-08 Identifying variable speed reducers	-	"	Plant Engineering Training Systems: Drive Components, Lesson Nine
DS-09 Identifying brakes and motors	-	"	Plant Engineering Training Systems: Drive Components, Lesson Ten
B-01 Identifying principles of bearings and shafts	-	McGraw-Hill: Maintenance Engineering Handbook	Plant Engineering Training Systems: Bearings, Lesson One
B-02 Identifying plain journal bearings	-	"	Plant Engineering Training Systems: Bearings, Lessons Two and Three
B-03 Identifying anti-friction bearings	-	"	Plant Engineering Training Systems: Bearings, Lessons Four and Five
B-04 Identifying ball and roller bearings	-	"	Plant Engineering Training Systems: Bearings, Lesson Six
B-05 Identifying specialized bearings	-	"	Plant Engineering Training Systems: Bearings, Lesson Seven
B-06 Identifying bearing seals	-	"	Plant Engineering Training Systems: Bearings, Lesson Eight
B-07 Identifying methods of bearing lubrication	-	"	Plant Engineering Training Systems: Bearings, Lesson Nine
B-08 Maintaining bearings	-	"	Plant Engineering Training Systems: Bearings, Lesson Ten

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
P-01	Identifying pump application	-	Black	Plant Engineering Training Systems: Pumps, Lesson One; Oregon, ILS: IM-HY-05
P-02	Selecting a pump	-	"	Plant Engineering Training Systems: Pumps, Lesson Two
P-03	Identifying centrifugal pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Three
P-04	Identifying propeller and turbine pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Four
P-05	Identifying rotary pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Five
P-06	Identifying reciprocating pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Six
P-07	Identifying metering pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Seven
P-08	Identifying special purpose pumps	-	"	Plant Engineering Training Systems: Pumps, Lesson Eight
P-09	Installing packings and maintaining pump seals	-	"	Plant Engineering Training Systems: Pumps, Lesson Nine
P-10	Performing pump maintenance	-	"	Plant Engineering Training Systems: Pumps, Lesson Ten
PS-01	Identifying piping systems and piping system maintenance		Audel; American Technical Society	Plant Engineering Training Systems: Piping Systems, Lesson One

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
PS-02 Maintaining metal pipe	Hobar: "Basic Plumbing Skills" (FS)	Audel; American Technical Society	Plant Engineering Training Systems: Piping Systems, Lesson Two
PS-03 Maintaining non-metallic pipe	Hobar: "Laboratory Exercises in Pipefitting" (ST)	"	Plant Engineering Training Systems: Piping Systems, Lesson Three
PS-04 Maintaining tubing	"	"	Plant Engineering Training Systems: Piping Systems, Lesson Four
PS-05 Maintaining hoses	-	"	Plant Engineering Training Systems: Piping Systems, Lesson Five
PS-06 Maintaining fittings	Hobar: "Laboratory Exercises in Pipefitting" (ST)	"	Plant Engineering Training Systems: Piping Systems, Lesson Six
PS-07 Maintaining common valves	"	"	Plant Engineering Training Systems: Piping Systems, Lesson Seven
PS-08 Identifying specialized valves	-	"	Plant Engineering Training Systems: Piping Systems, Lesson Eight
PS-09 Maintaining strainers, filters and traps	Hobar: "Laboratory Exercises in Pipefitting" (ST)	"	Plant Engineering Training Systems: Piping Systems, Lesson Nine
PS-10 Maintaining pipeline by monitoring accessories	-	"	Plant Engineering Training Systems: Piping Systems, Lesson Ten

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
BH-01 Identifying principles of hydraulics	Howard W. Sams and Co., Inc.: "Fluid Power" (TR)	Pease: ABC's of Hydraulic Circuits; Delmar: EMT Series, Fluids; Pippenger and Hicks	Plant Engineering Training Systems: Basic Hydraulics, Lesson One; Oregon, ILS: IM-HY-02
BH-02 Identifying hydraulic fluids	-	Pease: Pippenger and Hicks; Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Two
BH-03 Identifying strainers and filters in hydraulic systems	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Three
BH-04 Identifying reservoirs and accumulators in a hydraulic system	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Four; Oregon, ILS: IM-HY-07
BH-05 Identifying hydraulic pumps on a system	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Five; Oregon, ILS: IM-HY-05
BH-06 Identifying piping, tubing and fittings	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Six
BH-07 Identifying directional control valves	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Seven
BH-08 Identifying pressure control valves	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Eight; Oregon, ILS: IM-HY-06

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
BH-09 Identifying cylinders in a hydraulic system	-	Pease; Pippenger and Hicks; Morrow; Fluids	Plant Engineering Training Systems: Basic Hydraulics, Lesson Nine; Oregon, ILS: IM-HY-09
BH-10 Identifying hydraulic motors	-	"	Plant Engineering Training Systems: Basic Hydraulics, Lesson Ten
THS-01 Troubleshooting hydraulic systems (schematics)	-	Pease; Pippenger and Hicks	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson One
THS-02 Reading hydraulic schematic diagrams	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Two
THS-03 Installing hydraulic components	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Three
THS-04 Installing pipes and tubes	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Four
THS-05 Selecting hydraulic fluids	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Five
THS-06 Planning system maintenance	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Six

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
THS-07	Troubleshooting hydraulic systems (diagnostic technique)	-	Pease; Pippenger and Hicks	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Seven
THS-08	Troubleshooting valves	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Eight
THS-09	Troubleshooting cylinders	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Nine
THS-10	Troubleshooting pumps and motors	-	"	Plant Engineering Training Systems: Hydraulic Troubleshooting, Lesson Ten
BP-01	Identifying pneumatic principles	Bobbs-Merrill: "Fuild Power" (TR)	Pease; Stewart and Storer	Plant Engineering Training Systems: Basic Pneumatics, Lesson One; Bobbs-Merrill: Fluid Power
BP-02	Identifying reciprocating compressors	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Two; Fluid Power
BP-03	Identifying rotary compressors	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Three; Fluid Power
BP-04	Identifying primary air treatment in pneumatic systems	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Four; Fluid Power
BP-05	Identifying secondary air treatment methods	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Five; Fluid Power

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
BP-06	Identifying piping, hoses and fittings used in pneumatic systems	"	Pease; Stewart and Storer	Plant Engineering Training Systems: Basic Pneumatics, Lesson Six; Fluid Power
BP-07	Identifying control valves	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Seven; Fluid Power
BP-08	Identifying pressure relief valves	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Eight; Fluid Power
BP-09	Identifying cylinders	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Nine; Fluid Power
BP-10	Identifying motors	"	"	Plant Engineering Training Systems: Basic Pneumatics, Lesson Ten; Fluid Power
PT-01	Identifying components of pneumatic systems	"	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson One
PT-02	Reading pneumatic schemtaic diagrams	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Two
PT-03	Installing system components	"Fluid Power" (TR)	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Three
PT-04	Identifying precedures for pneumatic system maintenance	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Four
PT-05	Determining system failures	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Five

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TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
PT-06	Troubleshooting air compressors	-	Pease; Stewart and Storer	Plant Engineering Training Systems; Pneumatic Troubleshooting, Lesson Six
PT-07	Troubleshooting control valves	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Seven
PT-08	Troubleshooting cylinders	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Eight
PT-09	Troubleshooting air motors	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Nine
PT-10	Troubleshooting pneumatic/hydraulic systems	-	"	Plant Engineering Training Systems: Pneumatic Troubleshooting, Lesson Ten
IP-01	Identifying basic packaging methods	-	Kazanas, Gregor and Baker	Plant Engineering Training Systems: Introduction to Packaging, Lesson One
IP-02	Identifying actuating mechanisms	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Two
IP-03	Identifying basic troubleshooting principles of packaging machinery	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Three
IP-04	Identifying mechanical drives	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Four

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IP-05 Identifying motors and brakes	-	Kazanas, Gregor and Baker	Plant Engineering Training Systems: Introduction to Packaging, Lesson Five
IP-06 Identifying electrical controls	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Six
IP-07 Identifying packaging materials	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Seven
IP-08 Identifying methods of filling containers	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Eight
IP-09 Identifying methods of sealing	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Nine
IP-10 Identifying methods of weighing and measuring	-	"	Plant Engineering Training Systems: Introduction to Packaging, Lesson Ten
PM-01 Identifying methods of gravity and vacuum filling	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson One
PM-02 Identifying procedures for bottle filling and capping	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Two
PM-03 Identifying methods for pressure liquid filling	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Three

CURRICULUM AREA: Electro-Mechancial Technology

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
PM-04 Identifying aerosol fillers	-	Kazanas, Gregor and Baker	Plant Engineering Training Systems: Packaging Machinery, Lesson Four
PM-05 Identifying methods of bag forming and filling	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Five
PM-06 Identifying methods of pouch filling	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Six
PM-07 Identifying volumetric filling machines	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Seven
PM-08 Identifying filling by count machines	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Eight
PM-09 Identifying methods of positive displacement filling	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Nine
PM-10 Identifying methods of blister packing	-	"	Plant Engineering Training Systems: Packaging Machinery, Lesson Ten
CM-01 Identifying procedures for uncasing and unscrambling	-	New Jersey, Packaging Line Mechanics	Plant Engineering Training Systems: Casing Machinery, Lesson One
CM-02 Identifying procedures for cleaning and washing containers	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Two

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TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
CM-03 Identifying gathering machines	-	Packaging Line Mechanics	Plant Engineering Training Systems: Casing Machinery, Lesson Three
CM-04 Identifying cartoning machines	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Four
CM-05 Identifying casing machines	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Five
CM-06 Identifying wrapping machines	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Six
CM-07 Strapping and stitching packages	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Seven
CM-08 Identifying adhesives and their application	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Eight
CM-09 Identifying procedures for labeling and loding	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Nine
CM-10 Identifying procedures for maintenance and safety of casing machinery	-	"	Plant Engineering Training Systems: Casing Machinery, Lesson Ten

TEXTBOOK LIST

ABC's of Hydraulic Circuits. Howard W. Sams & Co., Inc.

Anton, Thomas J., Occupational Safety and Health Management. McGraw-Hill Book Co.

Black, Perry O., Pumps (3rd ed.). Howard W. Sams & Co., Inc.

Builder 3 & 2. Bureau of Naval Personnel, Government Printing Office.

Colburn, K. E., Fire Protection and Suppression. McGraw-Hill Book Co.

Collected Basic Circuits. Howard W. Sams & Co., Inc.

Developing Shop Safety Skills. AAVIM.

Dezettel, Louis M., Masons and Stone Builders Library (2nd ed.). Howard W. Sams & Co., Inc.

Electrical Wiring. AAVIM.

Electromechanical Technology Series. Delmar Publishers.

Feirer, John L., General Metals. McGraw-Hill Book Co.

Griffin, L. H., Roden, E. M. and Briggs, C. W., Welding Processes, (2nd ed.). Delmar.

Hinrichs, Roy S., Measuring. Delmar.

How to Design and Install Plumbing. American Technical Society.

How to Read Schematic Diagrams. Howard W. Sams & Co., Inc.

Industrial Mechanics. Oregon

Industrial Electronic Systems. Bobbs-Merrill Educational Publishing Co.

Johnson, Harold V., Technical Metals.

Jensen, C. and Hines, R., Interpreting Engineering Drawings.

Kazanas, H. C., Gregor, Thomas and Baker, Glenn E., Manufacturing Processes. McGraw-Hill Book Co.

Loper, Orla, E. and Ahr, Arthur, F., Electricity and Electronics, Research and Development Manual. Delmar Publishers, Inc.

Loper, Orla, E., Clendenning, Lee, R., Ahr, Arthur, F., Introduction To Electricity and Electronics. Delmar Publishers.

Ludwig, Oswald, A., McCarthy, Willard, J. and Kepp, Victor E., Metal Work Technology and Practice. McKnight Publishing Co.

Machine Tool Series (Vol. 2). Educational Methods.

Maintenance Engineering Handbook (2nd ed.). McGraw-Hill Book Co.

Mathematics for the Shop. Delmar Publishers.

Moore, Cairl, E., Concrete Form Construction. Delmar Publishers.

Olivio, C., Thomas and Olivio, Thomas, P., Fundamentals of Applied Physics. Delmar Publishers.

Oravitz, Jules, Sr., Plumbers and Pipe Fitters Library. Theodore Audel and Co.

Package, Line Mechanics. New-Jersey Vocational Technical Curriculum Laboratory.

Pease, Dudley, A., Basic Fluid Power. Prentice-Hall, Inc.

Pippenger, John, J. and Hicks, Tyler, G., Industrial Hydraulics. McGraw-Hill Book Co.

Practical Problems in Math. Hobar Publications.

Smith, Ronald, C., Principles and Practices of Heavy Construction. Prentice-Hall, Inc.

Richardson, Terry A., Modern Industrial Plastics. Howard W. Sams & Co.

Safety in Trade and Industrial Education Handbook. Instructional Materials Laboratory, University of Mo.

Schmidt, Lloyd H., Basic Plastics. Howard W. Sams & Co.

Smith, Electricity for Refrigeration, Heating, and Air-Conditioning. Prentice-Hall, Inc.

Smith, R. C., Materials of Construction. McGraw-Hill Book Co.

Standard Handbook of Lubrication Engineering. McGraw-Hill Book Co.

Stewart, Harry L. and Storer, John M., Fluid Power. Bobbs-Merrill Educational Publishering Co.

Sundberg, Elmer, Building Trades Blueprint Reading. American Technical Society.

Tools and Their Uses. U. S. Navy, Bureau of Naval Personnel, Dover Publications, Inc.

Walker, Modern Metal Working. Goodheart-Wilcox.

White, George, R., Concrete Technology. Delmar Publishers.

Willis, Charles D., Blueprint Reading for Commercial Construction. Delmar Publishers.

ADDITIONAL INSTRUCTIONAL RESOURCES
ITEM: TEXTBOOKS

Allen, D.K. and Mortensen, K.S., Metallurgy and Materials Science. American Tech.

Busch and Wilkie Bros. Foundation, Fundamentals of Dimensional Metrology. Delmar Publishers.

Chaplin, Jack W., Metal Manfacturing Technology. McKnight Publishing Company.

Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified. American Tech.

Gebert, Kenneth C., National Electrical Code Blueprint Reading. American Tech.

Graham, Kenneth C., Industrial and Commerical Wiring. (2nd ed.). American Tech.

Harris, Robert W., Drywall: Installation and Application. American Tech.

Huth, Mark W., Basic Construction Blueprint Reading. Delmar Publishers.

Johnson, Olaf A., Fluid Power: Pneumatics. American Tech.

Lightle, R. Paul, Blueprint Reading and Sketching. McKnight Publishing Company.

Miller, Rex, Dr., Industrial Electricity. Bennett Publishing Co.

McDonnell, L.P. and Kaumeheiwa, A.I., The Use of Portable Power Tools. Delmar Publishers.

McDonnell, L.P. and Kaumeheiwa, A.I., The Use of Handworking Tools. Delmar Publishers.

Neely, J., Practical Metallurgy and Materials of Industry. John Wiley and Sons.

Solaman, R.A., Dictionary of Tools. Bennett Publishing Company.

Swanson, Robert S., Plastics Technology. McKnight Publishing Company.

Wagner, Willis H., Modern Industry. American Tech.

ITEM: STUDENT MANUALS

Electromechanical Technology Series, Delmar Publishers, Titles Available: INTRODUCTORY MANUALS

- Motor Controls
- Devices
- Amplifiers
- Electricity
- Drives
- Linkages
- Fluids
- Optics

ADVANCED MANUALS

- Automatic Controls
- Servo-Mechanisms
- Fabrication
- Transducers
- Communication
- Digital
- Machines
- Materials

Kibbe, R.R., et al., Machine Tool Practices. John Wiley and Sons.

Loper, O.B. and Ahr, P.F., Electricity and Electronics Research and Development Manual. Delmar Publishers.

Oregon Board of Education, Mechanics. Oregon Board of Education

Related Information Electricity 1. Delmar Publishers.

ITEM: AUDIO-VISUALS

"Electric Motors-Service and Maintenance". Hobar Publications.

"Electrical and Basic Controls". Hobar Publications.

"Foundry Work". Bergwall Productions, Inc.

"Measuring Tools Explained". Bergwall Productions, Inc.

"Metal Corrosion Explained". Bergwall Productions, Inc.

"Micrometers, Calipers and Gages". Hobar Publications.

"Plastics". Prentice-Hall Media.

"Reading the Micrometer". Hobar Publications.

"Safety at Work". Prentice-Hall Media.

RESOURCE ADDRESSES
Written Materials

American Association for
Vocational Instructional
Materials
120 Engineering Center
Athens, GA 30602

American Tech
5608 Stony Island Avenue
Chicago, IL 60637

Bobbs-Merrill Educational
Publishing
4300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206

Chas. A. Bennett Co., Inc.
809 W. Detweiller Drive
Peoria, IL 61614

Continuing Education
Publications
P.O. Box 1394
Portland, OR 97207

Delmar Publishers
National Sales Office
50 Wolf Road
Albany, NY 12205

Dover Publications
180 Varick Street
New York, NY 10014

Educational Methods
Division of Development
Systems Corporation
Chicago, IL

Goodheart-Willcox
Company, Inc.
123 W. Tart Drive
South Holland, IL 60473

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112

McGraw-Hill Book Company
330 West 42nd Street
New York, NY 10036

Mid-America Vocational
Curriculum Consortium
1515 West Sixth Avenue
Stillwater, OK 74074

New Jersey Vocational-
Technical Curriculum
Laboratory
Rutgers-The State University
4103 Kilmer Campus
New Brunswick, NJ 08903

Oregon Board of Education
942 Lancaster Drive NE
Salem, OR 97310

Prentice Hall, Inc.
Englewood Cliffs, NJ

Superintendent of Documents
U.S. Government Printing
Office
Washington, DC 20402

Theodore Audel and Company
Howard W. Sams and Co., Inc.
4300 West 62nd Street
Indianapolis, IN 46206

RESOURCE ADDRESSES
Audio-Visuals

American Association for
Vocational Instructional
Materials
120 Engineering Center
Athens, GA 30601

Bergwall Productions, Inc.
Garden City, NY 11530

Bobbs-Merrill Educational
Publishing
4300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206

Career Aids, Inc.
8450 Lurline Avenue
Department T76
Chatsworth, CA 91311

DCA Educational Products
424 Valley Road
Warrington, PA 18976

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112

Howard W. Sams and Co.,
Inc.
4300 W. 62nd Street
Indianapolis, IN 46206

Prentice Hall Media
150 White Plains Road
Tarrytown, NY 10591

SECTION VII

STUDENT RECORDS

STUDENT RECORDS

This section contains five forms, the Individual Progress Report Chart, the Group Progress Chart, the Competency Checklist, the Certificate of Competency and the Student Competency Record. The use of these charts is described below.

INDIVIDUAL PROGRESS REPORT

One copy should be kept in each student's confidential file and updated as tasks are completed. Grades should be assigned upon task completion and then averaged for grade reporting. Difficulty, excessive amounts of time, etc. should be noted on this form and should be discussed with the student.

GROUP PROGRESS CHART

This chart reflects task completion only and can be displayed in the classroom or lab area. Due to confidentiality of records, a grade must not be recorded. The instructor should maintain a copy of this record and update it daily.

STUDENT COMPETENCY RECORD

This chart provides another method of maintaining an updated record of student performance. This record provides a listing of all tasks or units in the program, a space designated for the student's name, D.O.T. numbers and job title and a check off column for date of task completion. The D.O.T. number and job title should be filled in when the student leaves the program for any reason. The information will indicate his/her qualifications for a job. This information will be especially useful to early leavers who have not completed the total program.

INDIVIDUAL PROGRESS REPORT

NAME ______________________________

PROGRAM/ CLUSTER ______________________________ AREA ______________________________

TASK/ UNIT NO.	UNIT TITLE	DATE STARTED	DATE COMP.	EST. TIME	GRADE

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

COMPETENCY CHECKLIST

The Competency Checklist is an easy device for the instructor to use to know when a student is eligible to receive a Certificate of Competency (shown on page 9). One Checklist is used per student for as long as the student stays in the program. The instructor may use the checklist in the following manner:

1. Enter the student's name on the form.
2. As the student masters each task, check off the task under each job title on the Competency Checklist for which it appears.
3. Keep the Checklist in each student's personal file or keep all Competency Checklists together in a separate file.
4. When all the tasks underneath a job title have been checked off, the student is eligible to receive a Certificate of Competency for that job title.

CERTIFICATE OF COMPETENCY

The Certificate of Competency is issued by the instructor to certify that the student has mastered the tasks necessary for entry level employment for the job listed on the Certificate. The specific tasks that have been mastered are printed on the back of the Certificate, which can be used by the student to show a prospective employer exactly what the student is qualified to do. The Certificates should be printed ahead of time so that the instructor may simply fill in the front of the Certificate whenever a student is eligible to receive one, as indicated by the student's Competency Checklist. A sample completed Certificate of Competency appears on page 9 followed by a Certificate of Competency for each of the possible Industrial Electricity program exit points (job titles).

The Certificate should be completed by the instructor as follows:

1. Enter the student's name.
2. Enter the school name.
3. Date and sign the Certificate.
4. It is recommended that the Certificate be stamped with the school seal.

COMPETENCY CHECKLIST

____
Student Name

As the student masters each unit of instruction, check off the list number under each of the following job titles where it appears. When all the units under a job title have been completed, the student is eligible to receive a certificate of competency for that job title.

Required for All Job Titles

( ) SP-01
( ) SP-02
( ) SP-03
( ) SP-04
( ) SP-05
( ) SP-06
( ) SP-07
( ) SP-08
( ) SP-09
( ) SP-10
( ) L-01*
( ) L-02
( ) L-03
( ) L-04
( ) L-05
( ) L-06
( ) L-07
( ) L-08
( ) L-09
( ) L-10

Electrical Repairer
825.281-014

( ) BBR-01
( ) BBR-05
( ) BBR-06
( ) BBR-09
( ) BBR-10
( ) RSS-10 thru-05
( ) NMM-10
( ) T-01 thru-03
( ) T-05
( ) EM-01 thru-10
( ) DS-09
( ) IP-01 thru-07

Maintenance Repairer, Factory of Mill
849.281-014

( ) BBR-01 thru-08
( ) RSS-01 thru-10
( ) MM-01
( ) MM-02
( ) NMM-01 thru-10
( ) T-01 thru-10
( ) EM-07
( ) EM-08
( ) EM-09
( ) DS-01 thru-09
( ) B-01 thru-08
( ) P-01 thru P-10
( ) PS-01 thru P-10
( ) BH-01 thru-10
( ) THS-01 thru-10
( ) BP-01 thru-10
( ) PT-01 thru-10
( ) IP-01 thru-10
( ) PM-01 thru-10
( ) CM-01 thru-10

Maintenance Mechanic
638.381-014

( ) BBR-01 thru-10
( ) RSS-01 thru-10
( ) MM-01 thru-10
( ) NMM-01 thru-10
( ) T-01 thru-10
( ) EM-01 thru-10
( ) DS-01 thru-10
( ) B-01 thru-10
( ) P-01 thru-10
( ) PS-01 thru-10
( ) BH-01 thru-10
( ) THS-01 thru-10
( ) BP-01 thru-10
( ) PT-01 thru-10
( ) IP-01 thru-10
( ) PM-01 thru-10
( ) CM-01 thru-10

* Except Electrical Repairer

Maintenance Mechanic Helper
638.684-018

( ) BBR-01
( ) BBR-03
( ) RSS-01 thru-10
( ) MM-01
( ) MM-02
( ) NMM-01 thru-10
( ) T-01 thru-10
( ) EM-07
( ) EM-08
( ) EM-09
( ) DS-01 thru-09
( ) B-01 thru-08
( ) P-01 thru-10
( ) PS-01 thru-09
( ) BH-01 thru-10
( ) THS-03
( ) THS-04
( ) BP-01 thru-10
( ) PT-01
( ) PT-03
( ) IP-01 thru-10

Maintenance Repairer Helper
899.684-022

( ) BBR-01
( ) BBR-03
( ) RSS-01
( ) MM-01
( ) MM-02
( ) NMM-01 thru-10
( ) T-01 thru-10
( ) EM-07
( ) EM-08
( ) EM-09
( ) DS-01 thru-09
( ) B-01 thru-08
( ) P-01 thru-10
( ) PS-01 thru-10
( ) BH-01 thru-10
( ) THS-03
( ) THS-04
( ) BP-01 thru-10
( ) PT-01
( ) PT-03
( ) IP-01 thru-10

CERTIFICATE OF COMPETENCY

This is to Certify that

Joe Bennett

of

Athens Area Vo-Tech School

SAMPLE

has successfully mastered the competencies required to perform the job of ELECTRICAL REPAIRER.

Robert J. Warren

June 1, 1981

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrical Repairer.

ELECTRICAL REPAIRER
(D.O.T. 825.381-014)

BBR-01	Identifying basic principles of blueprint reading
BBR-05	Reading building drawings
BBR-06	Reading electrical drawings
BBR-09	Using shop math to interpret blueprints
BBR-10	Sketching schematic diagrams
RSS-01	Identifying types of schematics used in plant engineering
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams
RSS-03	Identifying guidelines for reading schematics
RSS-04	Identifying electrical symbols
RSS-05	Reading electrical diagrams
MM-10	Identifying processes used to produce lead, nickel, tin and zinc
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-05	Identifying and using electrical tools
EM-01	Identifying the nature of force
EM-02	Identifying physical properties of motion
EM-03	Identifying principles of work and energy
EM-04	Identifying principles of simple machines
EM-05	Identifying practical applications of power
EM-06	Calculating area and volume
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
EM-10	Identifying properties of fractions
SP-01	Identifying plant safety procedures
SP-02	Identifying work area safety
SP-03	Observing safety in handling materials
SP-04	Observing safety precautions for tools and equipment
SP-05	Identifying machinery safeguards
SP-06	Identifying personal protection gear
SP-07	Observing electrical safety precautions
SP-08	Handling hazardous materials
SP-09	Identifying fire prevention procedures
DS-09	Identifying brakes and motors
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of ELECTRICAL REPAIRER.

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrical Repairer.

ELECTRICAL REPAIRER
(D.O.T. 825.381-014)

BBR-01	Identifying basic principles of blueprint reading
BBR-05	Reading building drawings
BBR-06	Reading electrical drawings
BBR-09	Using shop math to interpret blueprints
BBR-10	Sketching schematic diagrams
RSS-01	Identifying types of schematics used in plant engineering
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams
RSS-03	Identifying guidelines for reading schematics
RSS-04	Identifying electrical symbols
RSS-05	Reading electrical diagrams
MM-10	Identifying processes used to produce lead, nickel, tin and zinc
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-05	Identifying and using electrical tools
EM-01	Identifying the nature of force
EM-02	Identifying physical properties of motion
EM-03	Identifying principles of work and energy
EM-04	Identifying principles of simple machines
EM-05	Identifying practical applications of power
EM-06	Calculating area and volume
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
EM-10	Identifying properties of fractions
SP-01	Identifying plant safety procedures
SP-02	Identifying work area safety
SP-03	Observing safety in handling materials
SP-04	Observing safety precautions for tools and equipment
SP-05	Identifying machinery safeguards
SP-06	Identifying personal protection gear
SP-07	Observing electrical safety precautions
SP-08	Handling hazardous materials
SP-09	Identifying fire prevention procedures
DS-09	Identifying brakes and motors
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of MAINTENANCE REPAIRER.

The student on this certificate has demonstrated mastery of the following tasks required to perform the job of Maintenance Repairer.

MAINTENANCE REPAIRER,
FACTORY OR MILL
(D.O.T. 849.281-014)

BBR-01	Identifying basic principles of blue print reading
BBR-02	Identifying elements of machine drawings
BBR-03	Identifying hydraulic and pueumatic drawings
BBR-04	Using machine drawings in the maintenance of machinery and equipment
BBR-05	Reading building drawings
BBR-06	Reading electrical drawings
BBR-07	Reading pipe system drawings
BBR-08	Reading sheet metal drawings
RSS-01	Identifying types of schematics used in plant engineering
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams
RSS-03	Identifying guidelines for reading schematics
RSS-04	Identifying electrical symbols
RSS-05	Reading electrical diagrams
RSS-06	Identifying piping symbols
RSS-07	Reading piping schematics
RSS-08	Identifying fluid power symbols
RSS-09	Reading fluid power schematics
RSS-10	Identifying welding symbols
MM-01	Identifying the physical structure of metals
MM-02	Identifying properties of metals
NMM-01	Identifying non-metal material
NMM-02	Identifying properties of plastics
NMM-03	Identifying properties of rubber
NMM-04	Identifying properties and applications of carbon
NMM-05	Identifying industrial chemicals and their applications
NMM-06	Identifying paints, coatings and their applications
NMM-07	Identifying insulating materials and their applications
NMM-08	Identifying properties and applications of construction materials
NMM-09	Identifying properties and applications of wood
NMM-10	Identifying adhesives and tapes
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-04	Identifying and using plumbing tools
T-05	Identifying and using electrical tools
T-06	Identifying and using cement, plaster and glazing tools
T-07	Identifying and using wood-working tools
T-08	Identifying and using sheet metal tools
T-09	Identifying and using metal working tools
T-10	Identifying and using hoisting and pulling tools
SP-01	Identifying plant safety procedures
SP-02	Identifying work area safety
SP-03	Observing safety in handling materials
SP-04	Observing safety precautions for tools and equipment
SP-05	Identifying machinery safeguards
SP-06	Identifying personal protection gear
SP-07	Observing electrical safety precautions
SP-08	Handling hazardous materials
SP-09	Identifying fire prevention procedures
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
DS-01	Identifying common couplings
DS-02	Identifying special couplings
DS-03	Identifying clutches
DS-04	Identifying V-belt drives
DS-05	Identifying chain drives
DS-06	Identifying speed reducers
DS-07	Identifying gears
DS-08	Identifying variable speed reducers
DS-09	Identifying brakes and motors
B-01	Identifying principles of bearings and shafts
B-02	Identifying plain journal bearings
B-03	Identifying anti-friction bearings
B-04	Identifying ball and roller bearings
B-05	Identifying specialized bearings
B-06	Identifying bearing seals
B-07	Identifying methods of bearing lubrication
B-08	Maintaining bearings
P-01	Identifying pump applications
P-02	Selecting a pump
P-03	Identifying centrifugal pumps
P-04	Identifying propeller and turbine pumps
P-05	Identifying rotary pumps
P-06	Identifying reciprocating pumps
P-07	Identifying metering pumps
P-08	Identifying special purpose pumps
P-09	Installing packings and maintaining pump seals
P-10	Performing pump maintenance
PS-01	Identifying piping systems and piping system maintenance
PS-02	Maintaining metal pipe
PS-03	Maintaining non-metallic piping
PS-04	Maintaining tubing
PS-05	Maintaining hoses
PS-06	Maintaining fittings

PS-07	Maintaining common valves
PS-08	Identifying specialized valves
PS-09	Maintaining strainers, filters and trays
PS-10	Maintaining pipe lines by maintaining accessories
BS-01	Identifying principles of hydraulics
BH-02	Identifying hydraulic fluids
BH-03	Identifying strainers and filters in hydraulic systems
BH-04	Identifying reservoirs and accumulators in a hydraulic system
BH-05	Identifying hydraulic pumps on a system
BH-06	Identifying piping, tubing and fittings
BH-07	Identifying directional control valves
BH-08	Identifying pressure control valves
BH-09	Identifying cylinders in a hydraulic system
BH-10	Identifying hydraulic motors
THS-01	Troubleshooting hydraulic systems
THS-02	Reading hydraulic schematic diagrams
THS-03	Installing hydraulic components
THS-04	Installing pipes and tubes
THS-05	Selecting hydraulic fluids
THS-06	Planning system maintenance
THS-07	Troubleshooting hydraulic systems (diagnostic technique)
THS-08	Troubleshooting valves
THS-09	Troubleshooting cylinders
THS-10	Troubleshooting pumps and motors
BP-01	Identifying pneumatic principles
BP-02	Identifying reciprocating compressors
BP-03	Identifying rotary compressors
BP-04	Identifying primary air treatment in pneumatic systems
BP-05	Identifying secondary air treatment in pneumatic systems
BP-06	Identifying piping, hoses and fittings used in pneumatic systems
BP-07	Identifying control valves
BP-08	Identifying pressure relief valves
BP-09	Identifying cylinders
BP-10	Identifying motors
PT-01	Identifying components of pneumatic systems
PT-02	Reading pneumatic schematic diagrams
PT-03	Installing system components
PT-04	Identifying procedures for pneumatic system maintenance
PT-05	Determining system failures
PT-06	Troubleshooting air compressors
PT-07	Troubleshooting control valves
PT-08	Troubleshooting cylinders
PT-09	Troubleshooting motors
PT-10	Troubleshooting pneumatic/hydraulic systems
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials
IP-08	Identifying methods of filling containers
IP-09	Identifying methods of sealing
IP-10	Identifying methods of weighing and measuring
PM-01	Identifying methods of gravity and vacuum filling
PM-02	Identifying procedures for bottle filling and capping
PM-03	Identifying methods for pressure liquid filling
PM-04	Identifying aerosal fillers
PM-05	Identifying methods of bag-forming and filling
PM-06	Identifying methods of pouch filling
PM-07	Identifying volumetric filling machines
PM-08	Identifying filling by count machines
PM-09	Identifying methods of positive displacement filling
PM-10	Identifying methods of blister packing
CM-01	Identifying procedures for uncasing and unscrambling
CM-02	Identifying procedures for cleaning and washing containers
CM-03	Identifying gathering machines
CM-04	Identifying cartoning machines
CM-05	Identifying casing machines
CM-06	Identifying wrapping machines
CM-07	Strapping and stitching packages
CM-08	Identifying adhesives and their application
CM-09	Identifying procedures for labeling and coding
CM-10	Identifying procedure for maintenance and safety of casing machinery

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of ______MAINTENANCE MECHANIC______.

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Maintenance Mechanic.

MAINTENANCE MECHANIC
(D.O.T. 638.281-014)

BBR-01	Identifying basic principles of blueprint reading
BBR-02	Identifying elements of machine drawings
BBR-03	Identifying hydraulic and pneumatic drawings
BBR-04	Using machine drawings in the maintenance of machinery and equipment
BBR-05	Reading building drawings
BBR-06	Reading electrical drawings
BBR-07	Reading pipe system drawings
BBR-08	Reading sheet metal drawings
BBR-09	Using shop math to interpret blueprints
BBR-10	Sketching schematic diagrams
RSS-01	Identifying types of schematics used in plant engineering
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams
RSS-03	Identifying guidelines for reading schematics
RSS-04	Identifying electrical symbols
RSS-05	Reading electrical diagrams
RSS-06	Identifying piping symbols
RSS-07	Reading piping schematics
RSS-08	Identifying fluid power symbols
RSS-09	Reading fluid power schematics
RSS-10	Identifying welding symbols
MM-01	Identifying the physical structure of metals
MM-02	Identifying properties of metals
MM-03	Identifying methods of heat treatment
MM-04	Identifying metal manufacturing processes
MM-05	Identifying iron manufacturing processes
MM-06	Identifying processes used to produce steel
MM-07	Identifying processes used to produce aluminum
MM-08	Identifying processes for the production of magnesium and titanium
MM-09	Identifying processes used to produce copper
MM-10	Identifying processes used to produce lead, nickel, tin and zinc
NMM-01	Identifying non-metal material
NMM-02	Identifying properties of plastics
NMM-03	Identifying properties of rubber
NMM-04	Identifying properties and applications of carbon
NMM-05	Identifying industrial chemicals and their applications
NMM-06	Identifying paints, coatings and their applications
NMM-07	Identifying insulating materials and their applications
NMM-08	Identifying properties and applications of construction materials
NMM-09	Identifying properties and applications of wood
NMM-10	Identifying adhesives and tapes
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-04	Identifying and using plumbing tools
T-05	Identifying and using electrical tools
T-06	Identifying and using cement, plaster and glazing tools
T-07	Identifying and using wood-working tools
T-08	Identifying and using sheet metal tools
T-09	Identifying and using metal working tools
T-10	Identifying and using hoisting and pulling tools
PS-01	Identifying plant safety procedures
PS-02	Identifying work area safety
PS-03	Observing safety in handling materials
PS-04	Observing safety precautions for tools and equipment
PS-05	Identifying machinery safeguards
PS-06	Identifying personal protection gear
PS-07	Observing electrical safety precautions
PS-08	Handling hazardous materials
PS-09	Identifying fire prevention procedures
EM-01	Identifying the nature of force
EM-02	Identifying physical properties of motion
EM-03	Identifying principles of work and energy
EM-04	Identifying principles of simple machines
EM-05	Identifying practical applications of power
EM-06	Calculating area and volume
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
EM-10	Identifying properties of friction
L-01	Identifying basic principles of lubrication
L-02	Identifying characteristics of lubricants
L-03	Identifying additives, lubricating action and bearing lubrication
L-04	Identifying oils and their applications
L-05	Identifying general purpose greases
L-06	Identifying special purpose greases
L-07	Identifying lubricating compounds
L-08	Identifying lubrication systems and methods
L-09	Identifying automatic lubrication methods
L-10	Identifying methods of lubricant storage and handling
DS-01	Identifying common couplings
DS-02	Identifying special couplings
DS-03	Identifying clutches
DS-04	Identifying V-belt drives
DS-05	Identifying chain drives

DS-06	Identifying speed reducers
DS-07	Identifying gears
DS-08	Identifying variable speed reducers
DS-09	Identifying brakes and motors
B-01	Identifying principles of bearings and shafts
B-02	Identifying plain journal bearings
B-03	Identifying anti-friction bearings
D-04	Identifying ball and roller bearings
B-05	Identifying specialized bearings
B-06	Identifying bearing seals
B-07	Identifying methods of bearing lubrication
B-08	Maintaining bearings
P-01	Identifying pump applications
P-02	Selecting a pump
P-03	Identifying centrifugal pumps
P-04	Identifying propeller and turbine pumps
P-05	Identifying rotary pumps
P-06	Identifying reciprocating pumps
P-07	Identifying metering pumps
P-08	Identifying special purpose pumps
P-09	Installing packings and maintaining pump seals
P-10	Performing pump maintenance
PS-01	Identifying piping systems and piping system maintenance
PS-02	Maintaining metal pipe
PS-03	Maintaining non-metallic piping
PS-04	Maintaining tubing
PS-05	Maintaining hoses
PS-06	Maintaining fittings
PS-07	Maintaining common valves
PS-08	Identifying specialized valves
PS-09	Maintaining strainers, filters and trays
PS-10	Maintaining pipe lines by maintaining accessories
BH-01	Identifying principles of hydraulics
BH-02	Identifying hydraulic fluids
BH-03	Identifying strainers and filters in hydraulic systems
BH-04	Identifying reservoirs and accumulators in a hydraulic system
BH-05	Identifying hydraulic pumps on a system
BH-06	Identifying piping, tubing and fittings
BH-07	Identifying directional control valves
BH-08	Identifying pressure control valves
BH-09	Identifying cylinders in a hydraulic system
BH-10	Identifying hydraulic motors
PM-01	Identifying methods of gravity and vacuum filling
PM-02	Identifying procedures for bottle filling and capping
PM-03	Identifying methods for pressure liquid filling
PM-04	Identifying aerosal fillers
PM-05	Identifying methods of bag-forming and filling
PM-06	Identifying methods of pouch filling
PM-07	Identifying volumetric filling machines
PM-08	Identifying filling by count machines
PM-09	Identifying methods of positive displacement filling
PM-10	Identifying methods of blister packing
CM-01	Identifying procedures for uncasing and unscrambling
CM-02	Identifying procedures for cleaning and washing containers
CM-03	Identifying gathering machines
CM-04	Identifying cartoning machines
CM-05	Identifying casing machines
CM-06	Identifying wrapping machines
CM-07	Strapping and stitching packages
CM-08	Identifying adhesives and their application
CM-09	Identifying procedures for labeling and coding
CM-10	Identifying procedure for maintenance and safety of casing machinery
THS-01	Troubleshooting hydraulic systems (schematics)
THS-02	Reading hydraulic schematic diagrams
THS-03	Installing hydraulic components
THS-04	Installing pipes and tubes
THS-05	Selecting hydraulic fluids
THS-06	Planning system maintenance
THS-07	Troubleshooting hydraulic systems (diagnostic technique)
THS-08	Troubleshooting valves
THS-09	Troubleshooting cylinders
THS-10	Troubleshooting pumps and motors
BP-01	Identifying pneumatic principles
BP-02	Identifying reciprocating compressors
BP-03	Identifying rotary compressors
BP-04	Identifying primary air treatment in pneumatic systems
BP-05	Identifying secondary air treatment in pneumatic systems
BP-06	Identifying piping, hoses and fittings used in pneumatic systems
BP-07	Identifying control valves
BP-08	Identifying pressure relief valves
BP-09	Identifying cylinders
BP-10	Identifying motors
PT-01	Identifying components of pneumatic systems
PT-02	Reading pneumatic schematic diagrams
PT-03	Installing system components
PT-04	Identifying procedures for pneumatic system maintenance
PT-05	Determining system failures
PT-06	Troubleshooting air compressors
PT-07	Troubleshooting control valves
PT-08	Troubleshooting cylinders
PT-09	Troubleshooting motors
PT-10	Troubleshooting pneumatic-hydraulic systems
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials
IP-08	Identifying methods of filling containers
IP-09	Identifying methods of sealing
IP-10	Identifying methods of weighing and measuring

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of ______MAINTENANCE MECHANIC HELPER______.

____

____

The student on this certificate has demonstrated mastery of the following tasks required to perform the job of Maintenance Mechanic Helper.

MAINTENANCE MECHANIC HELPER
(D.O.T. 638.684-018)

BBR-01	Identifying basic principles of blueprint reading
BBR-03	Identifying hydraulic and pneumatic drawings
RSS-01	Identifying types of schematics used in plant engineering
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams
RSS-03	Identifying guidelines for reading schematics
RSS-04	Identifying electrical symbols
RSS-05	Reading electrical diagrams
RSS-06	Identifying piping symbols
RSS-07	Reading piping schematics
RSS-08	Identifying fluid power symbols
RSS-09	Reading fluid power schematics
RSS-10	Identifying welding symbols
MM-01	Identifying the physical structure of metals
MM-02	Identifying properties of metals
NMM-01	Identifying non-metal material
NMM-02	Identifying properties of plastics
NMM-03	Identifying properties of rubber
NMM-04	Identifying properties and applications of carbon
NMM-05	Identifying industrial chemicals and their applications
NMM-06	Identifying paints, coatings and their applications
NMM-07	Identifying insulating materials and their applications
NMM-08	Identifying properties and applications of construction materials
NMM-09	Identifying properties and applications of wood
NMM-10	Identifying adhesives and tapes
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-04	Identifying and using plumbing tools
T-05	Identifying and using electrical tools
T-06	Identifying and using cement, plaster and glazing tools
T-07	Identifying and using wood-working tools
T-08	Identifying and using sheet metal tools
T-09	Identifying and using metal working tools
T-10	Identifying and using hoisting and pulling tools
SP-01	Identifying plant safety procedures
SP-02	Identifying work area safety
SP-03	Observing safety in handling materials
SP-04	Observing safety precautions for tools and equipment
SP-05	Identifying machinery safeguards
SP-06	Identifying personal protection gear
SP-07	Observing electrical safety precautions
SP-08	Handling hazardous materials
SP-09	Identifying fire prevention procedures
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
L-01	Identifying basic principles of lubrication
L-02	Identifying characteristics of lubricants
L-03	Identifying additives, lubricating action and bearing lubrication
L-04	Identifying oils and their applications
L-05	Identifying general purpose greases
L-06	Identifying special purpose greases
L-07	Identifying lubricating compounds
L-08	Identifying lubrication systems and methods
L-09	Identifying automatic lubrication methods

L-10	Identifying methods of lubricant storage and handling
DS-01	Identifying common couplings
DS-02	Identifying special couplings
DS-03	Identifying clutches
DS-04	Identifying V-belt drives
DS-05	Identifying chain drives
DS-06	Identifying speed reducers
DS-07	Identifying gears
DS-08	Identifying variable speed reducers
DS-09	Identifying brakes and motors
B-01	Identifying principles of bearings and shafts
B-02	Identifying plain journal bearings
B-03	Identifying anti-friction bearings
B-04	Identifying ball and roller bearings
B-05	Identifying specialized bearings
B-06	Identifying bearing seals
B-07	Identifying methods of bearing lubrication
B-08	Maintaining bearings
P-01	Identifying pump applications
P-02	Selecting a pump
P-03	Identifying centrifugal pumps
P-04	Identifying propeller and turbine pumps
P-05	Identifying rotary pumps
P-06	Identifying reciprocating pumps
P-07	Identifying metering pumps
P-08	Identifying special purpose pumps
P-09	Installing packings and maintaining pump seals
P-10	Performing pump maintenance
PS-01	Identifying piping systems and piping system maintenance
PS-02	Maintaining metal pipe
PS-03	Maintaining non-metallic piping
PS-04	Maintaining tubing
PS-05	Maintaining hoses
PS-06	Maintaining fittings
PS-07	Maintaining common valves
PS-08	Identifying specialized valves
PS-09	Maintaining strainers, filters and trays
PS-10	Maintaining pipe lines by maintaining accessories
BH-01	Identifying principles of hydraulics
BH-02	Identifying hydraulic fluids
BH-03	Identifying strainers and filters in hydraulic systems
BH-04	Identifying reservoirs and accumulators in a hydraulic system
BH-05	Identifying hydraulic pumps on a system
BH-06	Identifying piping, tubing and fittings
BH-07	Identifying directional control valves
BH-08	Identifying pressure control valves
BH-09	Identifying cylinders in a hydraulic system
BH-10	Identifying hydraulic motors
THS-03	Installing hydraulic components
THS-04	Installing pipes and tubes
BP-01	Identifying pneumatic principles
BP-02	Identifying reciprocating compressors
BP-03	Identifying rotary compressors
BP-04	Identifying primary air treatment in pneumatic systems
BP-05	Identifying secondary air treatment in pneumatic systems
BP-06	Identifying piping, hoses and fittings used in pneumatic systems
BP-07	Identifying control valves
BP-08	Identifying pressure relief valves
BP-09	Identifying cylinders
BP-10	Identifying motors
PT-01	Identifying components of pneumatic systems
PT-03	Installing system components
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials
IP-08	Identifying methods of filling containers
IP-09	Identifying methods of sealing
IP-10	Identifying methods of weighing and measuring

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of MAINTENANCE REPAIRER HELPER.

The student on this certificate has demonstrated mastery of the following tasks required to perform the job of Maintenance Repairer Helper.

MAINTENANCE REPAIRER
HELPER, FACTORY OR MILL
(D.O.T. 899.684-022)

BBR-01	Identifying basic principles of blueprint reading
BBR-02	Identifying elements of machine drawings
BBR-03	Identifying hydraulic and pneumatic drawings
RSS-01	Identifying types of schematics used in plant engineering
MM-01	Identifying the physical structure of metals
MM-02	Identifying properties of metals
NMM-01	Identifying non-metal material
NMM-02	Identifying properties of plastics
NMM-03	Identifying properties of rubber
NMM-04	Identifying properties and applications of carbon
NMM-05	Identifying industrial chemicals and their applications
NMM-06	Identifying paints, coatings and their applications
NMM-07	Identifying insulating materials and their applications
NMM-08	Identifying properties and applications of construction materials
NMM-09	Identifying properties and applications of wood
NMM-10	Identifying adhesives and tapes
T-01	Identifying and using measuring tools
T-02	Identifying and using wrenches and screwdrivers
T-03	Identifying and using pipefitting tools
T-04	Identifying and using plumbing tools
T-05	Identifying and using electrical tools
T-06	Identifying and using cement, plaster and glazing tools
T-07	Identifying and using wood-working tools
T-08	Identifying and using sheet metal tools
T-09	Identifying and using metal working tools
T-10	Identifying and using hoisting and pulling tools
SP-01	Identifying plant safety procedures
SP-02	Identifying work area safety
SP-03	Observing safety in handling materials
SP-04	Observing safety precautions for tools and equipment
SP-05	Identifying machinery safeguards
SP-06	Identifying personal protection gear
SP-07	Observing electrical safety precautions
SP-08	Handling hazardous materials
SP-09	Identifying fire prevention procedures
EM-07	Identifying and using hand tools
EM-08	Identifying and using power tools
EM-09	Identifying types of fasteners
L-01	Identifying basic principles of lubrication
L-02	Identifying characteristics of lubricants
L-03	Identifying additives, lubricating action and bearing lubrication
L-04	Identifying oils and their applications
L-05	Identifying general purpose greases
L-06	Identifying special purpose greases
L-07	Identifying lubricating compounds
L-08	Identifying lubrication systems and methods
L-09	Identifying automatic lubrication methods
L-10	Identifying methods of lubricant storage and handling
DS-01	Identifying common couplings
DS-02	Identifying special couplings
DS-03	Identifying clutches
DS-04	Identifying V-belt drives

DS-05	Identifying chain drives
DS-06	Identifying speed reducers
DS-07	Identifying gears
DS-08	Identifying variable speed reducers
DS-09	Identifying brakes and motors
B-01	Identifying principles of bearings and shafts
B-02	Identifying plain journal bearings
B-03	Identifying anti-friction bearings
B-04	Identifying ball and roller bearings
B-05	Identifying specialized bearings
B-06	Identifying bearing seals
B-07	Identifying methods of bearing lubrication
B-08	Maintaining bearings
P-01	Identifying pump applications
P-02	Selecting a pump
P-03	Identifying centrifugal pumps
P-04	Identifying propeller and turbine pumps
P-05	Identifying rotary pumps
P-06	Identifying reciprocating pumps
P-07	Identifying metering pumps
P-08	Identifying special purpose pumps
P-09	Installing packings and maintaining pump seals
P-10	Performing pump maintenance
PS-01	Identifying piping systems and piping system maintenance
PS-02	Maintaining metal pipe
PS-03	Maintaining non-metallic piping
PS-04	Maintaining tubing
PS-05	Maintaining hoses
PS-06	Maintaining fittings
PS-07	Maintaining common valves
PS-08	Identifying specialized valves
PS-09	Maintaining strainers, filters and trays
PS-10	Maintaining pipe lines by maintaining accessories
BH-01	Identifying principles of hydraulics
BH-02	Identifying hydraulic fluids
BH-03	Identifying strainers and filters in hydraulic systems
BH-04	Identifying reservoirs and accumulators in a hydraulic system
BH-05	Identifying hydraulic pumps on a system
BH-06	Identifying piping, tubing and fittings
BH-07	Identifying directional control valves
BH-08	Identifying pressure control valves
BH-09	Identifying cylinders in a hydraulic system
BH-10	Identifying hydraulic motors
THS-03	Installing hydraulic components
THS-04	Installing pipes and tubes
BP-01	Identifying pneumatic principles
BP-02	Identifying reciprocating compressors
BP-03	Identifying rotary compressors
BP-04	Identifying primary air treatment in pneumatic systems
BP-05	Identifying secondary air treatment in pneumatic systems
BP-06	Identifying piping, hoses and fittings used in pneumatic systems
BP-07	Identifying control valves
BP-08	Identifying pressure relief valves
BP-09	Identifying cylinders
BP-10	Identifying motors
PT-01	Identifying components of pneumatic systems
PT-03	Installing system components
IP-01	Identifying basic packaging methods
IP-02	Identifying actuating mechanisms
IP-03	Identifying basic troubleshooting principles of packaging machinery
IP-04	Identifying mechanical drives
IP-05	Identifying motors and brakes
IP-06	Identifying electrical controls
IP-07	Identifying packaging materials
IP-08	Identifying methods of filling containers
IP-09	Identifying methods of sealing
IP-10	Identifying methods of weighing and measuring

RECORD OF DEMONSTRATED JOB COMPETENCIES

STUDENT NAME ______________________________ PROGRAM ________________________________

DICTIONARY OF OCCUPATIONAL TITLES JOB CLASSIFICATION:

D.O.T. No. ____________________________________

JOB TITLE ____________________________________

Unit No.	Competency Demonstrated	Initial Date
	Basic Blueprint Reading	
BBR-01	Identifying basic principles of blueprint reading	
BBR-02	Identifying elements of machine drawings	
BBR-03	Identifying hydraulic and pneumatic drawings	
BBR-04	Using machine drawings in the maintenance of machinery and equipment	
BBR-05	Reading building drawings	
BBR-06	Reading electrical drawings	
BBR-07	Reading pipe system drawings	
BBR-08	Reading sheet metal drawings	
BBR-09	Using shop math to interpret blueprints	
BBR-10	Sketching schematic diagrams	
	Reading Schematics and Symbols	
RSS-01	Identifying types of schematics used in plant engineering	
RSS-02	Identifying the symbols on electrical, piping and fluid power diagrams	
RSS-03	Identifying guidelines for reading schematics	
RSS-04	Identifying electrical symbols	
RSS-05	Reading electrical diagrams	
RSS-06	Identifying piping symbols	
RSS-07	Reading piping schematics	
RSS-08	Identifying fluid power symbols	
RSS-09	Reading fluid power schematics	
RSS-10	Identifying welding symbols	
	Metal Materials	
MM-01	Identifying the physical structure of metals	
MM-02	Identifying properties of metals	
MM-03	Identifying methods of heat treatment	
MM-04	Identifying metal manufacturing processes	
MM-05	Identifying iron manufacturing processes	
MM-06	Identifying processes used to produce steel	
MM-07	Identifying processes used to produce aluminum	
MM-08	Identifying processes for the production of magnesium and titanium	
MM-09	Identifying processes used to produce copper	
MM-10	Identifying processes used to produce lead, nickel, tin and zinc	
	Non-Metal Materials	
NMM-01	Identifying non-metal material	
NMM-02	Identifying properties of plastics	
NMM-03	Identifying properties of rubber	
NMM-04	Identifying properties and applications of carbon	
NMM-05	Identifying industrial chemicals and their applications	
NMM-06	Identifying paints, coatings and their applications	
NMM-07	Identifying insulating materials and their applications	
NMM-08	Identifying properties and applications of construction materials	
NMM-09	Identifying properties and applications of wood	
NMM-10	Identifying adhesives and tapes	
	Tools	
T-01	Identifying and using measuring tools	
T-02	Identifying and using wrenches and screwdrivers	
T-03	Identifying and using pipefitting tools	
T-04	Identifying and using plumbing tools	
T-05	Identifying and using electrical tools	
T-06	Identifying and using cement, plaster and glazing tools	
T-07	Identifying and using wood-working tools	
T-08	Identifying and using sheet metal tools	
T-09	Identifying and using metal working tools	
T-10	Identifying and using hoisting and pulling tools	
	Plant Safety	
SP-01	Identifying plant safety procedures	
SP-02	Identifying work area safety	
SP-03	Observing safety in handling materials	
SP-04	Observing safety precautions for tools and equipment	

Unit No.	Competency Demonstrated	Initial Date
SP-05	Identifying machinery safeguards	
SP-06	Identifying personal protection gear	
SP-07	Observing electrical safety precautions	
SP-08	Handling hazardous materials	
SP-09	Identifying fire prevention procedures	
	Elements of Mechanics	
EM-01	Identifying the nature of force	
EM-02	Identifying physical properties of motion	
EM-03	Identifying principles of work and energy	
EM-04	Identifying principles of simple machines	
EM-05	Identifying practical applications of power	
EM-06	Calculating area and volume	
EM-07	Identifying and using hand tools	
EM-08	Identifying and using power tools	
EM-09	Identifying types of fasteners	
EM-10	Identifying properties of friction	
	Lubricants	
L-01	Identifying basic principles of lubrication	
L-02	Identifying characteristics of lubricants	
L-03	Identifying additives, lubricating action and bearing lubrication	
L-04	Identifying oils and their applications	
L-05	Identifying general purpose greases	
L-06	Identifying special purpose greases	
L-07	Identifying lubricating compounds	
L-08	Identifying lubrication systems and methods	
L-09	Identifying automatic lubrication methods	
L-10	Identifying methods of lubricant storage and handling	
	Drive Systems	
DS-01	Identifying common couplings	
DS-02	Identifying special couplings	
DS-03	Identifying clutches	
DS-04	Identifying V-belt drives	
DS-05	Identifying chain drives	
DS-06	Identifying speed reducers	
DS-07	Identifying gears	
DS-08	Identifying variable speed reducers	
DS-09	Identifying brakes and motors	
	Bearings	
B-01	Identifying principles of bearings and shafts	
B-02	Identifying plain journal bearings	
B-03	Identifying anti-friction bearings	
B-04	Identifying ball and roller bearings	
B-05	Identifying specialized bearings	
B-06	Identifying bearing seals	
B-07	Identifying methods of bearing lubrication	
B-08	Maintaining bearings	
	Pumps	
P-01	Identifying pump applications	
P-02	Selecting a pump	
P-03	Identifying centrifugal pumps	
P-04	Identifying propeller and turbine pumps	
P-05	Identifying rotary pumps	
P-06	Identifying reciprocating pumps	
P-07	Identifying metering pumps	
P-08	Identifying special purpose pumps	
P-09	Installing packings and maintaining pump seals	
P-10	Performing pump maintenance	
	Piping Systems	
PS-01	Identifying piping systems and piping system maintenance	
PS-02	Maintaining metal pipe	
PS-03	Maintaining non-metallic piping	
PS-04	Maintaining tubing	
PS-05	Maintaining hoses	
PS-06	Maintaining fittings	
PS-07	Maintaining common valves	
PS-08	Identifying specialized valves	
PS-09	Maintaining strainers, filters and trays	
PS-10	Maintaining pipe lines by maintaining accessories	
	Basic Hydraulics	
BH-01	Identifying principles of hydraulics	
BH-02	Identifying hydraulic fluids	
BH-03	Identifying strainers and filters in hydraulic systems	
BH-04	Identifying reservoirs and accumulators in a hydraulic system	
BH-05	Identifying hydraulic pumps on a system	
BH-06	Identifying piping, tubing and fittings	
BH-07	Identifying directional control valves	
BH-08	Identifying pressure control valves	
BH-09	Identifying cylinders in a hydraulic system	
BH-10	Identifying hydraulic motors	
	Troubleshooting Hydraulic Systems	
THS-01	Troubleshooting hydraulic systems	

Unit No.	Competency Demonstrated	Initial Date
	(schematics)	
THS-02	Reading hydraulic schematic diagrams	
THS-03	Installing hydraulic components	
THS-04	Installing pipes and tubes	
THS-05	Selecting hydraulic fluids	
THS-06	Planning system maintenance	
THS-07	Troubleshooting hydraulic systems (diagnostic technique)	
THS-08	Troubleshooting valves	
THS-09	Troubleshooting cylinders	
THS-10	Troubleshooting pumps and motors	
	Basic Pneumatics	
BP-01	Identifying pneumatic principles	
BP-02	Identifying reciprocating compressors	
BP-03	Identifying rotary compressors	
BP-04	Identifying primary air treatment in pneumatic systems	
BP-05	Identifying secondary air treatment in pneumatic systems	
BP-06	Identifying piping, hoses and fittings used in pneumatic systems	
BP-07	Identifying control valves	
BP-08	Identifying pressure relief valves	
BP-09	Identifying cylinders	
BP-10	Identifying motors	
	Pneumatic Troubleshooting	
PT-01	Identifying components of pneumatic systems	
PT-02	Reading pneumatic schematic diagrams	
PT-03	Installing system components	
PT-04	Identifying procedures for pneumatic system maintenance	
PT-05	Determining system failures	
PT-06	Troubleshooting air compressors	
PT-07	Troubleshooting control valves	
PT-08	Troubleshooting cylinders	
PT-09	Troubleshooting motors	
PT-10	Troubleshooting pneumatic/hydraulic systems	
	Introduction to Packaging	
IP-01	Identifying basic packaging methods	
IP-02	Identifying actuating mechanisms	
IP-03	Identifying basic troubleshooting principles of packaging machinery	
IP-04	Identifying mechanical drives	
IP-05	Identifying motors and brakes	
IP-06	Identifying electrical controls	
IP-07	Identifying packaging materials	
IP-08	Identifying methods of filling containers	
IP-09	Identifying methods of sealing	
IP-10	Identifying methods of weighing and measuring	
	Packing Machinery	
PM-01	Identifying methods of gravity and vacuum filling	
PM-02	Identifying procedures for bottle filling and capping	
PM-03	Identifying methods for pressure liquid filling	
PM-04	Identifying aerosal fillers	
PM-05	Identifying methods of bag-forming and filling	
PM-06	Identifying methods of pouch filling	
PM-07	Identifying volumetric filling machines	
PM-08	Identifying filling by count machines	
PM-09	Identifying methods of positive displacement filling	
PM-10	Identifying methods of blister packing	
	Casing Machinery	
CM-01	Identifying procedures for uncasing and unscrambling	
CM-02	Identifying procedures for cleaning and washing containers	
CM-03	Identifying gathering machines	
CM-04	Identifying cartoning machines	
CM-05	Identifying casing machines	
CM-06	Identifying wrapping machines	
CM-07	Strapping and stitching packages	
CM-08	Identifying adhesives and their application	
CM-09	Identifying procedures for labeling and coding	
CM-10	Identifying procedure for maintenance and safety of casing machinery	

SECTION VIII

SPECIAL NEEDS STUDENT

WORKING WITH SPECIAL NEEDS STUDENTS

Introduction

Special needs students are those who are designated as handicapped and/or disadvantaged. The 1976 vocational education amendment defines handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In Title II of the 1976 education amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special people be given an opportunity to function in a regular classroom. This section provides information on how special needs students are identified and how they can be mainstreamed into regular educational environments.

Figure One presents a model depicting various activities of the process in identifying and mainstreaming special needs students. These activities are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification Of The Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the

SPECIAL NEEDS MAINSTREAMING MODEL

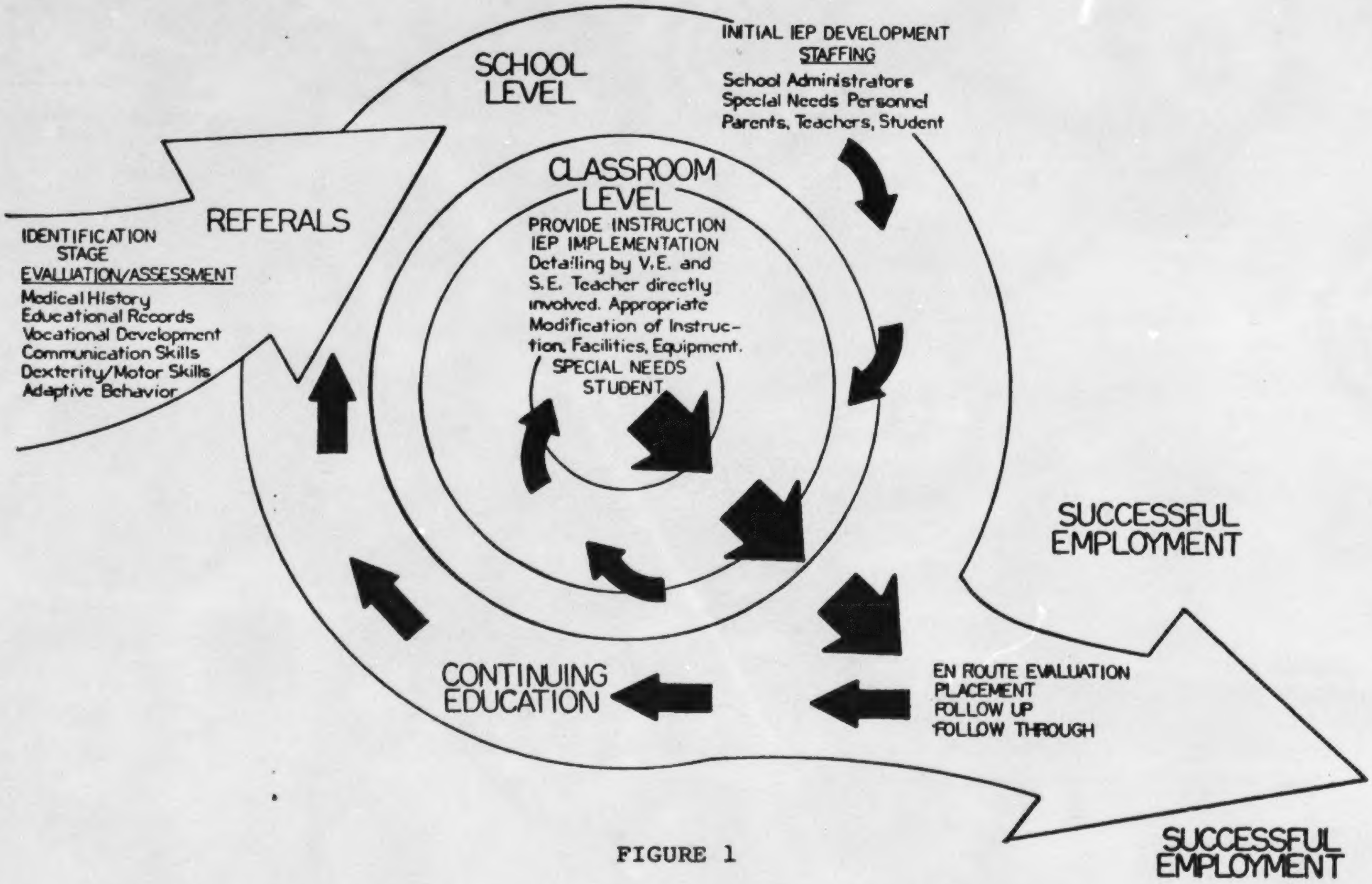

SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Student
REFERALS
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
EN ROUTE EVALUATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

FIGURE 1

system level. This evaluation process consists of collecting and assessing the following data for each student:

- -Medical History
- -Educational Records
- -Vocational Development
- -Communication Skills
- -Dexterity/Motor Skills
- -Adaptive Behavior

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel.

Development of the Plan

At the school level, an Individual Education Plan (IEP) is developed for each special needs student. An IEP is a written plan which describes the educational objectives, both long and short term, and the support services for a special needs student. The plan is developed by the school administration, special education personnel, teacher(s) directly involved with the student and the parent(s). In some cases, the student may help with the development.

Implementing the I.E.P.

The actual implementing of the I.E.P. begins at the classroom level. The purpose of the teacher dealing with the special needs student is to help the student set realistic goals, identify the barriers which make it difficult for the student to learn and adapt the curriculum and/or facilities with reference to the I.E.P. so the student can learn while overcoming personal barriers.

Special needs students have problems which hinder their learning. Therefore, a teacher's job becomes more complicated than when teaching "regular" students. Handicapped students may have a variety of problems - mental, physical and/or emotional.

Academically disadvantaged students may exhibit language deficiencies, reading and writing deficiencies, computational deficiencies and general educational deficiencies. Economically disadvantaged students may possess an inability to concentrate because their primary needs - food, shelter, clothing - are not adequately met due to lack of money.

By considering these problems, teachers can modify existing programs to accommodate the needs of special needs learners. Some suggestions which may prove beneficial in modifying an existing curriculum are listed below:

- Prepare instructional materials in greater detail and assign work in shorter units.
- Provide more frequent evaluation of student's progress and provide opportunities for remedial work.
- Be aware of the student's limited vocabulary.
- Be aware of the student's inability to understand abstractions and generalizations and prepare materials accordingly.
- Keep the student aware of his or her progress and make the student feel he or she can succeed.
- Use real teaching aids, live work and practical experiences whenever possible.
- Choose reading material which is at the student's level, interest and experience.
- Use constructive criticism only.
- Use peer instruction whenever possible.
- Allow the student to advance at his or her own pace.
- Use the part-to-whole learning concept in adapting materials.

Materials Which Can Be Used to Teach Disadvantaged

In Georgia an effective set of materials has been developed to be used with a program to help disadvantaged students adjust to life and work situations. This program is called CVAE or Coordinated Vocational Academic Education. The CVAE program is organized with a coordinator who is responsible for the type of instruction the students receive, and a team of teachers assigned to the coordinator who work cooperatively to help the disadvantaged students learn to enjoy school and become more successful students. CVAE materials include visuals in the form of synchronized slide/tape presentations. These units are designed to help the disadvantaged student become more successful in school, learn good work habits, become an aware consumer, and develop a better self-image and appearance. (Although designed especially for disadvantaged students, CVAE may also be used in regular classroom situations). The vocational education teacher should work with the CVAE coordinator to design a program of study for the disadvantaged students in areas in which the student needs help.

In some cases, facilities, must be modified for handicapped special needs students. In general, as long as the classroom/shop meets federal guidelines for barrier free design, extensive facility changes need not be made. For visually impaired students, for example, let the student locate in the classroom where he or she can see best even to the point of moving the desk or work station as a portable unit. In the case of orthopedically handicapped, some changes may have to be made to shop machinery to allow the student to use it. This may involve more convenient controls or special seating where the student would normally stand. In making these changes, special education expertise would be helpful.

Evaluation

Evaluation of the student's program should consist of:

- -En-route evaluation (formative) to monitor the student's progress through the program.
- -Summative evaluation upon completion of the program to determine job readiness.
- -Follow-up after placement to determine if the student is successful on the job.
- -Follow-through activities designed to identify any further training needed, which is indicated by the follow-up procedure.

Working with special needs students is much more demanding of the system, the school and the classroom teacher. However, with their patience and understanding, special needs students can not only succeed, but in many cases excell.

RESOURCES

To aid the teacher in modifying materials for special needs categories, the following references are listed by category. These are suggested references only as a world of materials exist on this subject.

Mentally Retarded

A Curriculum Guide for Teachers of Educable Mentally Retarded. Danville, Ill.: The Interstate Printers and Publishing Co., Inc.

High, Elizabeth C., and Moyers, Kathy L. Training Manual: Developing Pre-Vocational/Vocational Skills in Developmentally Disabled Persons. Washington, D.C.: Job Development Laboratory, George Washington University, 1976.

Kolstoe, Oliver P. Teaching Educable Mentally Retarded Children. Holt, Rinehart and Winston, 1976.

Mulligan, Robert E.; Gavin, Donald and Conaley, James. Comprehensive Career Education Curriculum Guide for the Trainable. New Brunswick, N.J.: Rutgers Vocational-Technical Curriculum Laboratory, 1977.

Introduction to Vocations for Educable Mentally Retarded. New Jersey: New Jersey Department of Education.

State of Ohio Curriculum Guide for Moderately Retarded Learners. Columbus, Ohio: Ohio Department of Education, 1977.

Tucker, Mark M. Learning through Curriculum Modification; A Blueprint to Teaching the Mentally Retarded. Johnstown, PA.: Mafex Associates, Inc., 1976.

Watson, Marjorie. Mainstreaming the Educable Mentally Retarded. Washington, D.C., NEA, 1975.

Hearing Impaired

Alvin, Howard P. The Evolution of an Evaluation Design for Evaluating Secondary Programs for the Deaf in Vocational Occupational-Technical Education (VOTE) Programs. ERIC - ED 123-241.

Guidelines: Educational Planning for the Hearing Handicapped. North Carolina Public Schools. Division for Exceptional Children, North Carolina Department of Public Instruction, Raleigh, N.C., 1977.

Munson, Harold L.; Eglston, Judy Cobb and Phillips, Gordon B. *Career Education for Deaf Students: An Inservice Leader's Guide*. University of Rochester, College of Education, Center for the Study of Helping Services, Rochester, N.Y. 1975.

Nix, Gary W. *Mainstreaming Education for Hearing Impaired Children and Youth*. Grune and Stratton, 1976.

Orthopedically and Other Health

A Model Plan for a Cooperative Vocational Rehabilitation Program. Office of Human Development, Rehabilitation Services and Administration. Department of Health, Education and Welfare, Washington, D.C.

Mallix, Kalisanker and Mueller, Jim. *Vocational Aids and Enhanced Productivity of the Severely Disabled*. The George Washington University Rehabilitation Research and Training Center, Washington, D.C. 1975.

McCarthy, Henry and Smart, Landon. *Recommendations for Enhancing Employment Prospects of Handicapped Individuals*. Comps. Human Resources Center, Albertson, L. I., 1978.

Duncan, John, et al. *Environmental Modifications for the Visually Impaired: A Handbook*. Visual Impairment and Blindness, December 1977, p. 442-455.

Disadvantaged

Guidelines for Methods and Techniques of Teaching Disadvantaged Students. Division of Vocational Education, Virginia Polytechnic Institute and State University, Blackburg, VA.

A Handbook for Developing Programs and Services for Disadvantaged Students. Department of Vocational Education Studies, College of Education, Southern Illinois, University of Carbondale, Carbondale, Ill. 62901

By Program

Adaption of Home Economics Curricula for Special Needs. North Dakota Research Coordination Unit, State Board for Vocational Education, State Office Building, Bismarck, ND.

Auto Body: An Adaptive and Developmental Program for Special Needs Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Floriculture Board of Cooperative Educational Services of Nassaw County, Division of Occupational Education, Division of Special Education, Westburg, NY 1975.

Grubb, Francine. Basic Business - A Teacher's Guide to an Employment Orientation Course for Special Needs Students. Vocational Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Home Economics and the Exceptional Student: A Handbook for Home Economics Teachers Working with Mentally Retarded Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Troutman, Carol M. Introduction to Office Occupations. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1974.

Working with the Handicapped in the Vocational Home Economics Classroom. Division of Vocational Education, State of Ohio, Columbus, Ohio.

Coordinated Vocational Education and Training (C.V.E.T.) manuals for disadvantaged, available from: Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1515 West Sixth Avenue, Stillwater, Oklahoma 74074.

-CVET Construction	3100219	Teacher's Guide
	3100209	Student
-CVET General Mechanics	3100239	Teacher's Guide
	3100229	Student

General Special Needs

A Handbook for Modifying Vocational Curricula for Handicapped Students. Wisconsin Vocational Studies Center, University of Wisconsin, Madison, May 1980.

Bottoms, J.E. and Scott, C.P. Supportive services for special student groups. In J.E. Wall (ed.), Vocational Education for Special Groups. Sixth Yearbook, Washington, D.C.: American Vocational Association, 1976.

Gill, Douglas H. and Scott, C. Paul. A practical model for mainstreaming handicapped learners in vocational education. The Journal for Vocational Special Needs Education, Vol. 1, No. 3, April, 1979, pp. 3-7.

Gugerty, J., et al. Tools, Equipment and Machinery Adapted for the Vocational Educator and Employment of the Handicapped. Project #498749006, Wisconsin Vocational Studies Center, Madison, Wisconsin, January 1981.

Hull, Marc E., Berry, Owen J. and Clark, Donald L. Procedures for Teaching Vocational Concepts to Students with Special Needs. Texas A & M University, Final Report Project 62350274, June 1976.

The Related Vocational Instruction Program. Georgia's Approach to Vocational Education for the Handicapped at the Secondary level, Douglas H. Gill, Project Coordinator, Vocational Programs for the Handicapped, Georgia Southern College, Statesboro, Georgia.

Vocational Educational Resource Materials, A Bibliography of Materials for Handicapped and Special Education. Third edition, 1978. Wisconsin Vocational Studies Center, University of Wisconsin - Madison.

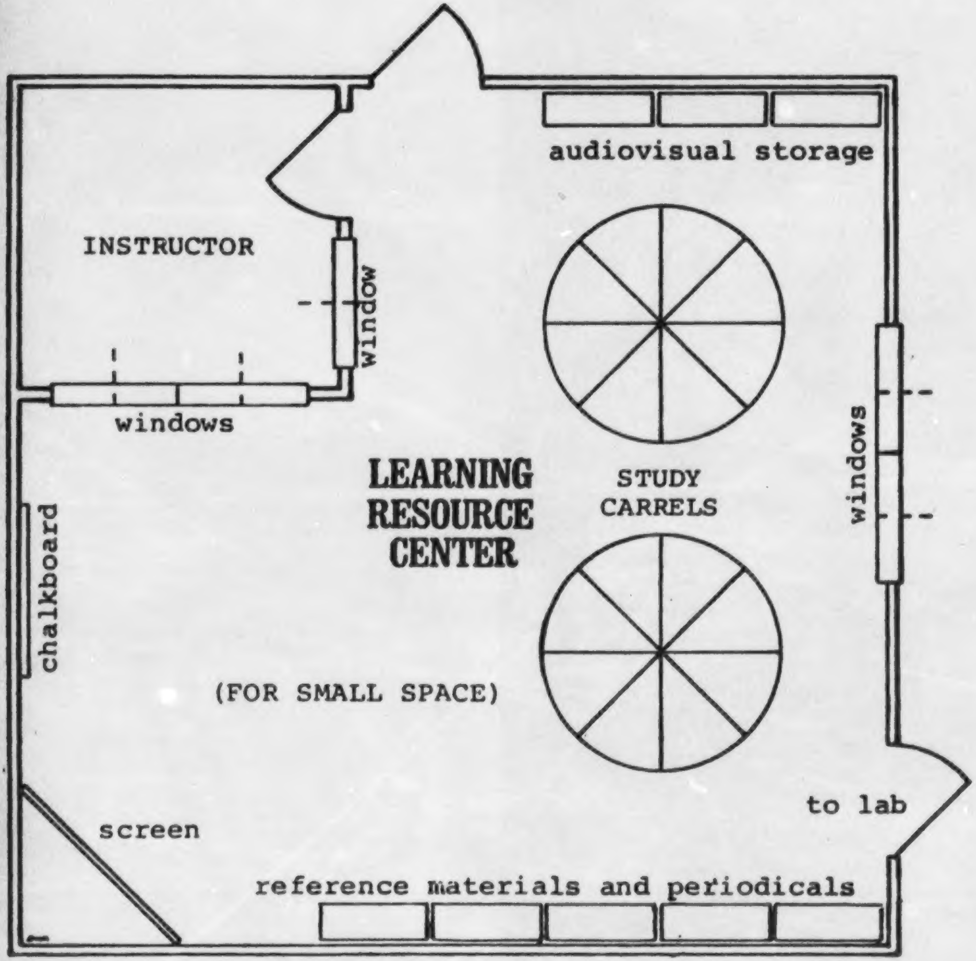
SECTION IX

FACILITY LAYOUT

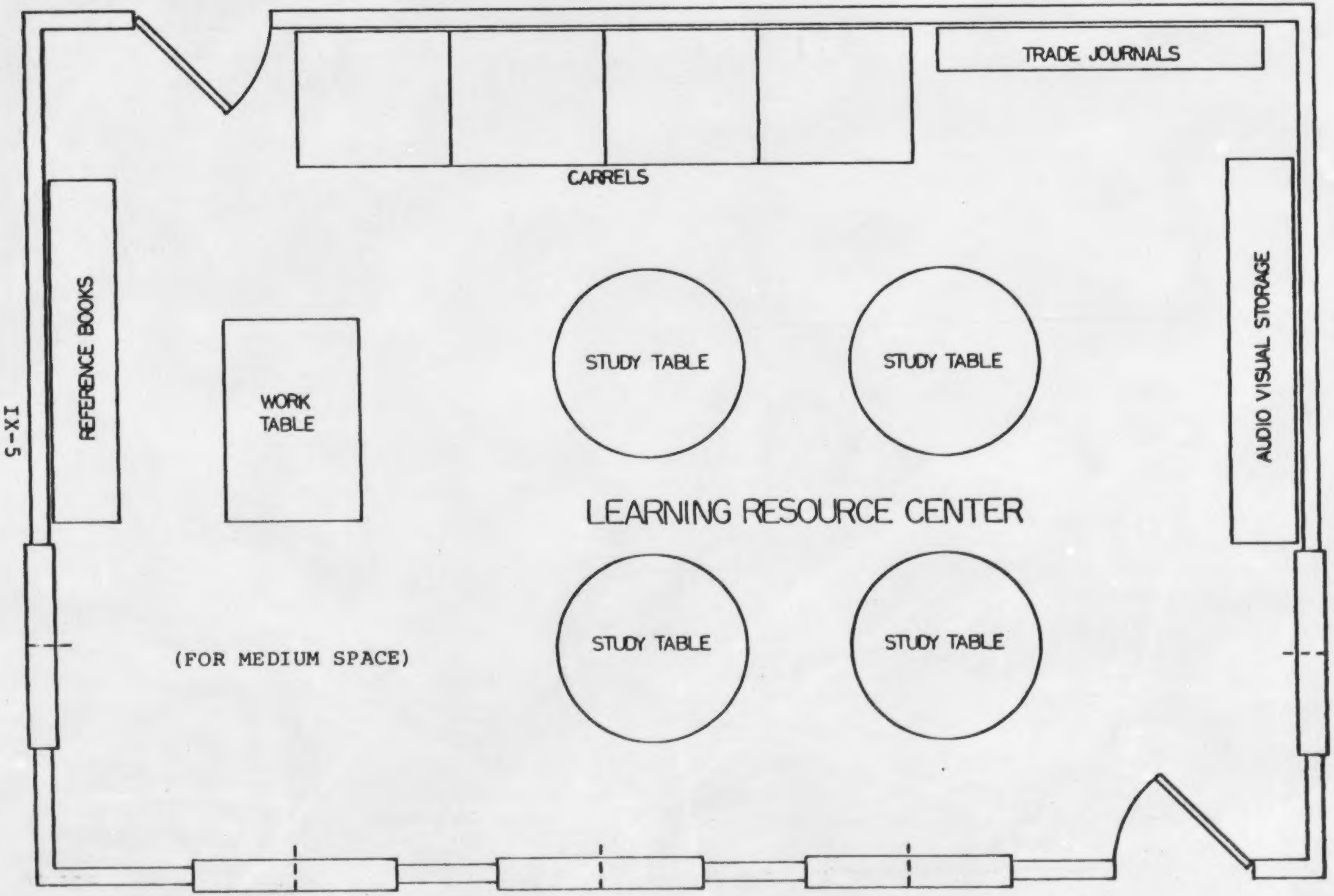
Facility Layout

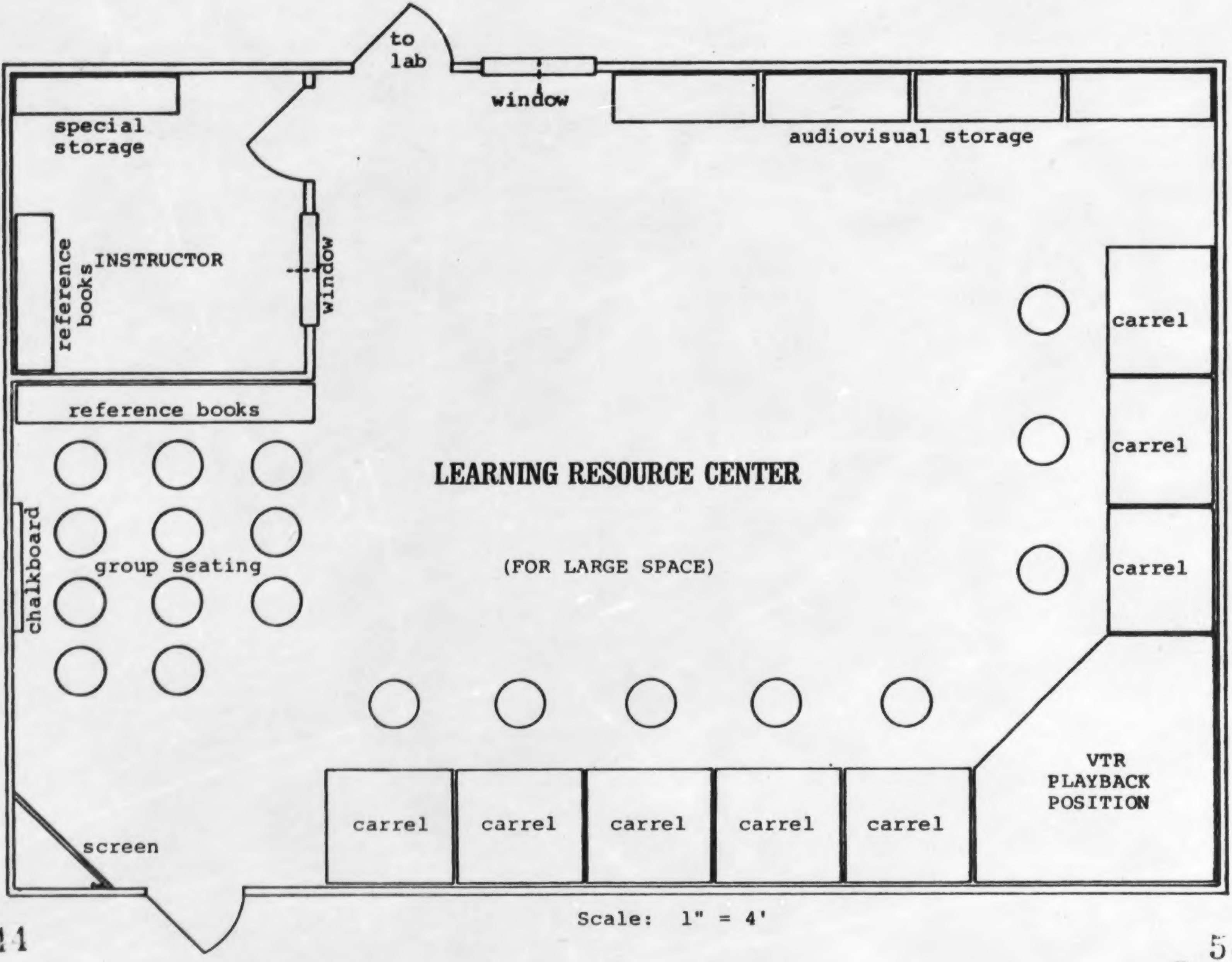
The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. Ultimately, the instructor must determine an arrangement that best fits the needs of the students and the instructional method being used.

This facility layout is based on one of Georgia's Electro-Mechanical Technology programs. It is easily adaptable to a variety of arrangements that will best fit local needs and resources. The layout may be especially useful in those schools where classroom renovation or construction is being planned.


audiovisual storage
INSTRUCTOR
window
windows
LEARNING RESOURCE CENTER
STUDY CARRELS
windows
chalkboard
(FOR SMALL SPACE)
to lab
screen
reference materials and periodicals

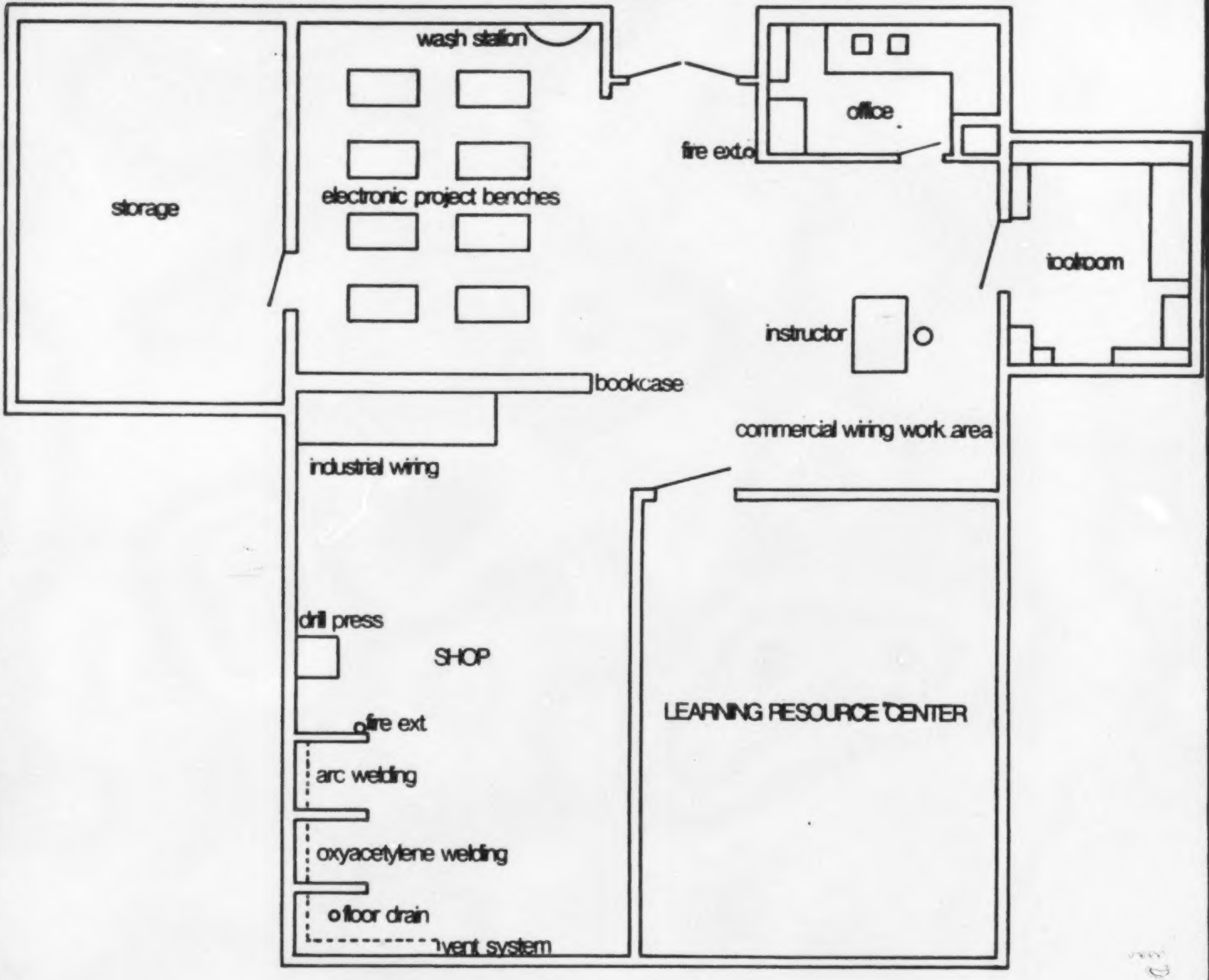
Scale: 1" = 4'


TRADE JOURNALS
CARRELS
REFERENCE BOOKS
WORK TABLE
STUDY TABLE
STUDY TABLE
AUDIO VISUAL STORAGE
LEARNING RESOURCE CENTER
STUDY TABLE
STUDY TABLE
(FOR MEDIUM SPACE)


to lab
window
special storage
audiovisual storage
reference books
INSTRUCTOR
window
reference books
LEARNING RESOURCE CENTER
(FOR LARGE SPACE)
chalkboard
group seating
carrel
carrel
carrel
VTR PLAYBACK POSITION
carrel
carrel
carrel
carrel
carrel
screen

Scale: 1" = 4'

ELECTRO-MECHANICAL TECHNOLOGY LABORATORY


wash station
office
fire ext.
electronic project benches
storage
toolroom
instructor
bookcase
commercial wiring work area
industrial wiring
drill press
SHOP
LEARNING RESOURCE CENTER
fire ext
arc welding
oxyacetylene welding
floor drain
vent system

SECTION X

DEFINITION OF TERMS

DEFINITION OF TERMS

1. AV's-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting the statement of a competency includes expected student outcomes in terms of knowledge, skills, and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization, and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed, comprising related tasks.

10. Exit Point - A predetermined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing for a student to progress at their fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U. S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes their occupational objective.

22. Performance Guide - A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. Performance - The specific behavior expected of the learner is stated.

c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the students' ability to operate, manipulate, or perform a given task as well.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which the student can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from the simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures or job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training materials; generally covering one learning task and programmed on one Unit Sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V-TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data, organized by a job structure or career ladder within a domain of interest.

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Title II - Loydia Webber, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

Inquiries concerning the application of Title II, Title VI, Title IX or Section 504 to the policies and practices of the department may be addressed to the persons listed above at the Georgia Department of Education, State Office Building, Atlanta 30334; to the Regional Office for Civil Rights, Atlanta 30323; or to the Director, Office for Civil Rights, Education Department, Washington, D.C. 20201.